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American Fern Journal

A QUARTERLY DEVOTED TO FERNS

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AMERICAN FERN SOCIETY

EDITORS

C. V. MORTON

R. C. BENEDICT IRA L. WIGGINS

A. C. SMITH

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American Fern Journal

VOL. 48 JANUARY-MARCH, 1958 NO. 1

An Amateur Plants Fern Spores[1]

KATHRYN BOYDSTON

To plant infinitesimal spores and then (eventually) to watch the unfolding ferns of many forms and sizes has been an absorbing interest, a fascinating hobby, a thrilling and rewarding experience of the past three years. Many others have done the same thing and probably the only reason I have been asked to write of my experiments is to show that it is an easy possibility open to anyone with a window-sill or a few square feet of space. If your interest isn't keen at planting time, I assure you it will be aroused by those first tiny pricks of green, will mount when these green points turn into lovely ruffled prothallia, and will reach fever-pitch when these give rise to the tiny sporophytes (usually like very small clover or violet leaves at first) which are the beginnings of the true fern. At every stage, such a lively green!

There have been some failures and disappointments, but surprisingly so many more successes. In a few particulars, I have had to do things a bit differently from methods described in the American Fern Journal, and these will be mentioned, but the main fact of interest to those who have seen my ferns is the large number I have been able to grow in a very small space.

The little porch shown in the accompanying picture is smaller even than it looks, scarcely 6 × 8 feet in all, and what is there now was not really planned. Like Topsy,

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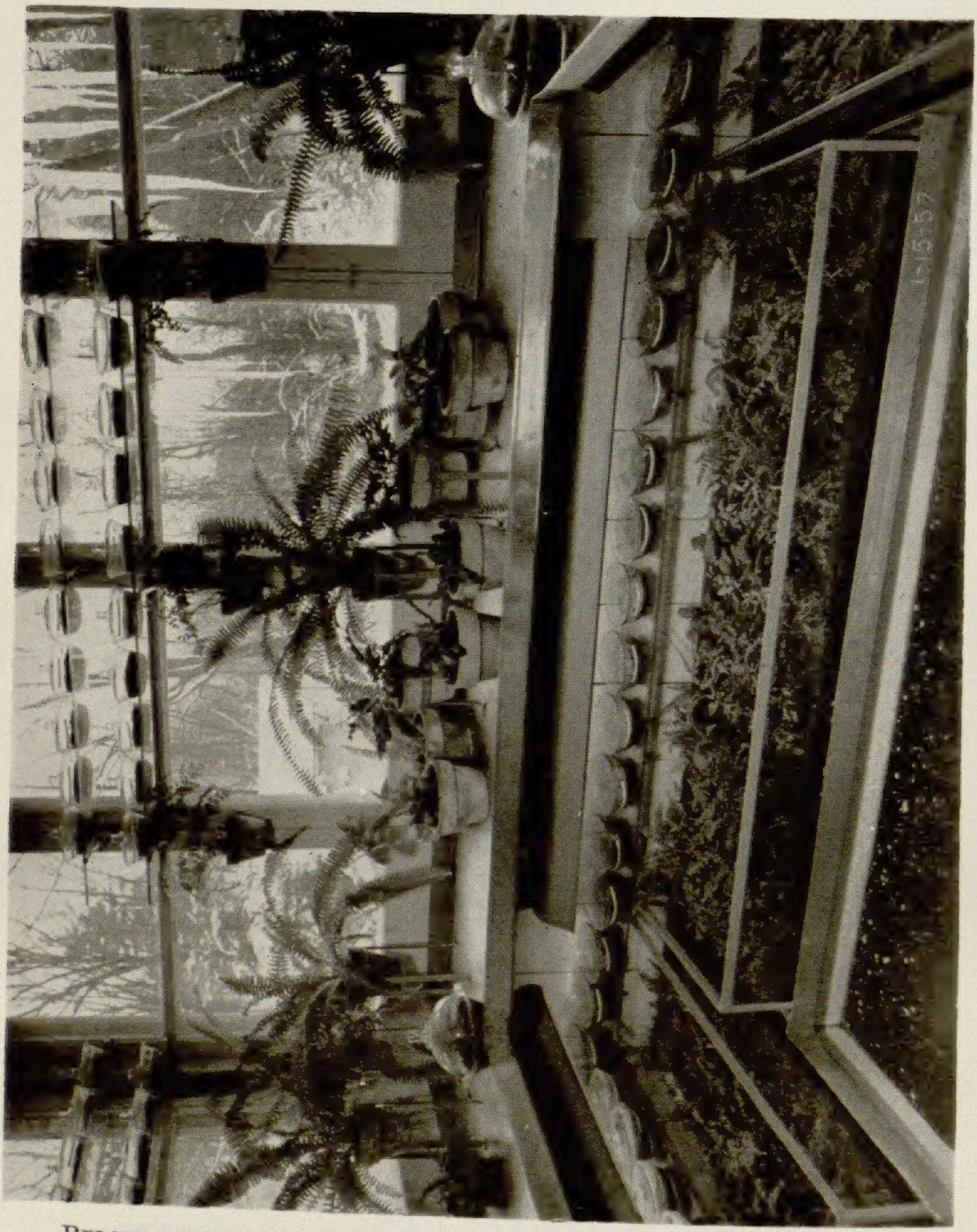
[1] A paper delivered at the Annual Meeting of the American Fern Society, Stanford University, August 26, 1957.

[Volume 47, No. 4, of the JOURNAL pp. 129–168, was issued December 26, 1957.]



BELOW SPORE PLANTINGS IN DISHES AND SPORELINGS IN CASE; ABOVE ADIANTUMS, CHEILANTHES, PHYLLITIS, AND NEPHROLEPIS POTTED AND BROUGHT IN FOR WINTER; PHOTOGRAPH JANUARY 15, 1957

"it just grew," and it might never have come about at all except for my fortunate meeting with our late treasurer Mr. Matt Mann on the Vermont-New York Fern Society field trip in 1952.

START OF INTEREST

For many years, I had been torn between two compulsions, an insatiable interest in ferns and a deep belief in conservation. There was a strong urge in me to see or to have every fern I heard or read about. The more I had, the more I wanted, whether they were in a connoisseurs' catalogue, in a lovely woods, or just beyond a barbed-wire fence. Especially did I crave the smaller rock-loving ferns, and the rarer they were, the more I desired them! My urge to conserve kept me within bounds, and though I am quite sure I'd never have denuded a rock of its rare Aspleniums or touched a rarer hart's-tongue, this did not in the least lessen my wanting them.

Mr. Matthew Mann claimed to be an amateur, yet he was successfully growing many ferns in a roughly made propagating box in his basement. His methods were described and his propagator pictured later in the Journal.[2] As he gathered a few bits of fertile fronds on the trip, or shook spores into an envelope, he generously answered my many questions and added his assurance that if he could do it, I could too. He gave me a bit of each kind he gathered and thus opened up a whole new world to me as I realized that perhaps some of these long-wanted, nearly-gone, or extremely rare ferns might be grown right here, and this as a help to conservation rather than a hindrance!

INSTALLATION OF EQUIPMENT

Instead of the basement for propagation, I began to

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[2] Benedict, R. C., Aids to Spore Culture. This JOURNAL 45: 60–64. 1955.

think of this small back porch which had little or no use except to serve as a catchall for galoshes, coke bottles, and grocery boxes. Off the too-small kitchen, it was an eyesore to everyone yet a propagating box such as Mr. Mann described would not be welcome here either, as it would be in full view of everyone coming in the front door. Instead of being closed up in a box *with* the fluorescent light, why not enclose and cover the spore plantings with glass and have the fluorescent light *outside* the glass? Little by little this idea was worked out, but only after many and devious dealings with many and different men. First the carpenter who moved the permanent outside door of the kitchen to the west side of the porch, built a new flight of steps to it, added a second series of windows to match those already there, insulated floor and ceiling and the wall below the windows and built two U-shaped shelves around the outside wall.

Next, an electrician who installed the lights just below the top shelf, a double-tube 48″ fluorescent light with shade reflector for the center part and a matching 24″ double-tube light for each end section. Happily, the top of these reflectors was painted light gray. An inexpensive chicken-brooder timer was installed inside the broom closet to automatically turn the lights on and off at appointed times. We chose an 18 hour light day (for no particular reason except that some advice was for 16 hours, some for 20–24) and they come on at 5 :00 a.m. and go off at 11 :00 p.m.

Now a part of the kitchen, the floors, had to be made to match, and all the new wood had to be painted a creamy light yellow like the kitchen walls. Then the search began for someone to make large pans to hold the pots of plants and drip therefrom. From their quoted prices, some of those we talked to I'm sure thought we wanted platinum rather than aluminum. Finally, they were made in Chicago, these two large U-shaped pans

each of them all in one piece with 2″ sides and when they arrived in their heavy large crates, had to be met at the station with a borrowed truck. The top one fell into place a perfect fit. The bottom one could in no way be made to fit. Unable to be tipped because of the broom closet at one end and the house wall on the other, it finally had to be taken again by truck to South Bend to be cut in two and new sides welded on. Next, brackets and glass shelves. The carpenter had through a misunderstanding put a 6″ wooden shelf all around, half way between the two shelves. Though this would keep light from reaching the lower area, it gave me the idea of a glass shelf in the same position to hold many dishes of planted spores—to save space and add interest at the same time.

Up to this time I had intended to use many ivies or scented geraniums or other house plants on the top shelf, the fern plantings to be only below the lights. At first there were some, but I blamed them for an infestation of thrips that later attacked hart's-tongue and other tender fern morsels below. Since then, no house plant has found room. The ferns have taken over and have proved a surprisingly magnetic attraction to all who enter the front door and see them for the first time.

That first fall I tried planting spores gathered here and on the 1952 and 1953 Fern Society trips. All the recommended ways were tried. In fact I planted spores of *Pellaea atropurpurea* and of *Asplenium platyneuron* in six ways each. On the same day, spores from the same fronds were planted: (1) on sterilized soil, (2) on porous brick set in water, (3) on tuffa pieces set in water, (4) on an inverted sphagnum-filled clay flower pot, (5) on pure peat, and (6) on finely-sieved sphagnum. Each was glass-covered. With both species the soil was so far superior in amount as well as promptness of germina-

Close-up of part of lower case in Pl. 1, showing sporelings in rows: Cheilanthes lanosa, Camptosorus rhizophyllus, Polypodium vulgare, and Camptosorus sibericus

tion, it has been used in all later work since then.

This first planting was fairly successful, but there was something so untidy about all these glass-covered pots of varying size and condition that it was far from satisfying and was the cause of Rule No. 1 being set up for all future plans or decisions concerning this room: That concern for congenial conditions for the ferns must be equalled or overruled by eye-appeal and convenience to the humans occupying or visiting this home. This dictated the answer to our present problem. Clay pots would be banished in favor of glass dishes for planting of spores. These would be pyrex, which could be boiled, baked or steamed. A row of them looked very perky on the glass shelves. These were 18 round pyrex dishes 5″ in diameter, which were already on hand and just the right number to fill the long shelf. So round pieces of glass to fit were ordered and purchased.

No more like these could be found anywhere, all pyrex casseroles having meantime grown ear-like handles on each side and a knob on their covers. The smallest size of these was chosen and 13 bought (for 15¢ each) for use on the two side shelves.

The intention was to transplant later into other pans or pyrex dishes perhaps, which could be glass-covered. When the time came, however, there were so many little ferns, half would have to be thrown out if this method were to be followed. Of necessity, then, was born the idea of planting these in rows directly in the soil of a large terrarium-like case. So again we started our trek from one man to another to find someone to make three frames of one-inch metal, 7 inches high (no bottoms—just side-braces) to hold pieces of glass. These frames are light, easy to set into the big pan, and the metal we painted light gray to match the aluminum. The four pieces of glass in each one are slipped in and held temporarily to the sides with scotch tape until the layers of

crushed stone and soil are put in, which later hold the glass in place. When not in use, the glass can be cleaned and stored in flat pieces and the frames hung on the tool-house wall. One, two, or three may be used at one time.

At times, these large terrarium cases must be glass-covered. There is one piece to fit each of the two end cases. The center case has two pieces of such size that there are all together four different lengths (all the same width). When the glass is to be removed, they can be shifted around to let in gradually more air without shock to the ferns.

By this time, Dr. Benedict had conceived of the Fern Society Spore Exchange and knowing of my enthusiasm for my newest venture asked me to take charge of it. This was a challenge and an opportunity. As I began to receive spores and also to gather more kinds myself, it was soon apparent that more dishes were called for: 27 were bought for the upper shelves (intended for pots of ivies, etc.), and Hang-a-pot holders were put up, three on the window frames and three on the side of the broom closet.

The seven two-year-old Nephrolepis' on the summer porch must come in soon but were too large to rest on the shelf. So, we found a man to make some simple pot stands that would raise their pots 11″ above shelf level. These were painted the same light gray of the frames below. They added considerable interest by varying the heights.

Additions last year included the two gray pottery hanging baskets seen in *Plate 3*, a second complete row of window shelves, and 27 more dishes! As the spring was cold and late, the ferns in the lower cases shown in *Plate 1* had outgrown their quarters. More elbow room and root room were needed. So three "collars" of the same heavy aluminum were made to fit the

top pan. (Like the sides of a box they were, with no bottom.) This allows $3\frac{1}{2}''$ of soil and space for many more rows of plants. They too may be used one, two, or three at a time as need dictates and are easily stored when not in use.

So now, at long last, I finally must agree with my husband that there can be no more expansion of this small space! What started as a minor alteration in deference to an untried new hobby had turned into a major project over a space of three years. The result is a neat, compact place of soft yellow background where, aside from green ferns, only glass and aluminum and aluminum-colored paint are seen. The soft lights enhance the beauty of the green plants, especially at night, bidding a cheerful welcome at all times and continuing to be a constant source of interest to all.

Only one more thing is needed. Some kind of shade to protect dishes and plants above the lights from the winter sun. In summer there are enough shade trees outside, but when the winter sun does shine through the glass, it has been necessary to shade the dishes with a strip of paper or cheesecloth. I plan now to weave some matchstick push-back shades. Instead of the bright colors usually used, these will have only the same light gray and soft yellow already in the room, so as not to detract attention from the ferns.

There are all told 14 feet of 6″ shelf under lights to accomodate 31 dishes and 20 feet more above (with just window light) for 54 dishes. In all then, 85 dishes for planted spores and the gametophyte stage (the beginnings of life) of as many ferns, each in its own humid, sterilized space.

In the lower cases, there are about 14 square feet of soil space where row upon row of the "patches" of tiny ferns grow from glass-covered "babyhood" to uncovered "childhood" under the lights; and above, the shelves are

LARGER PLANTS FROM LOWER CASE MOVED TO WINDOW HEIGHT BENCH MADE BY THE ADDITION OF ALUMINUM "COLLARS"; PHOTOGRAPH MAY 25, 1957

2″ wider, offering about 16½ square feet for rows of larger ferns in their "youth."

General Procedure

So much for the background, the existing physical set-up, and the future of ferns raised therein. Now a little about actual procedures, many of which, in order to conform to Rule No. 1 as set forth above, have been contrary to written and spoken advice. All activities have been "strictly amateur" and have not gone on long enough or extensively enough to draw any definite "conclusions." "Observations" would be a better word, and a few are offered here with the idea that some others of no botanical or laboratory experience may have been deterred, as I was, from embarking on this adventure by such mysterious-sounding phrases and directions as "sterile petri dishes," "stock solutions of mineral nutrient," "a liter of diluted solution," "store spores in gelatin capsules," or "sow spores through an atomizer," "agar must be sterilized, cooled and jelled," etc. etc. Here there is no agar, no nutrient solutions, and no laboratory equipment. All of it is easy, except for the transplanting and general shifting about that takes place about four times a year and which does require a good deal of time in carrying soil in and out and in washing dishes. At all other times there is very little time spent compared to the pleasure received.

Soils

My soil mixture is unmeasured, but roughly the usual 1/3 leaf-mould, 1/3 sand, and 1/3 soil. If leaf-mould is scarce, peat is substituted. Each ingredient is put through a 1/4″ mesh sieve, then well mixed. Some of this mixture, which should have a "good feel" (if it doesn't, add more leaf-mould or peat), is then sifted through the fine mesh of an ordinary window screen. Both mixtures are then sterilized in roasting pans in the

kitchen oven set at 350° for 2 or 3 hours. Quite a bit of water is added to each roaster in order to create steam in the oven.

Meanwhile, the dishes are washed and sterilized in a hot-water-bath canner. The first time, I followed someone's directions to put the soil in the dishes and sterilize all at one time. But the water evaporated, leaving the soil to harden onto the sides of the dish in an unsightly and unremovable ring. Since then they have always been sterilized separately.

When the soil has cooled sufficiently the finer mixture is spooned into the dishes, or used as the top layer in the cases where the tiny patches will be planted. The coarser mixture is all right for the under-layer and for anywhere that larger ferns will be planted.

A mistake of my first planting was in filling in the soil too near the top of the dish as I was accustomed to doing in planting seeds, only to find later there was no space for the prothallia and tiny ferns to grow, yet these still have to be glass-covered. I realized that very little soil is needed at this beginning stage, so now leave at least 3/4 inch of space between soil and glass. It is gently tamped into a smooth flat surface with any flat-bottomed glass or tamper. If it seems too dry, some distilled water is added and the cover put on.

One other point which seems unlikely but true: The type of soil seems to be unimportant in influencing germination. Acid and lime-loving alike germinate on the same soil mixture. For later growth, one of the side cases above and one below are filled with an acid soil for those species that require it.

PLANTING

When all dishes to be planted are thus prepared, they are taken, one at a time, into another room to be planted. Here only one envelope of one kind of spore is opened, a few spores are shaken or scraped with the back of a table

knife onto a white clean paper, and then put through the finest tea-strainer I could find onto a second white paper, and then examined with a hand-lens or magnifying glass to be sure the microscopic spores are really there. They are then planted by tapping the paper over the dish. Even with this care in planting one kind at a time and using clean paper, there are still spores in the air and later on in many cases surprising additions to those planted sometimes appear in the rows.

PARASITES AND PESTS

In spite of oven sterilizations of the soil (which of course is not a laboratory-sure-proof method) occasionally a dish shows spots of a gray mould. If seen and acted on quickly, the rapid spread of the mould over the whole dish can sometimes, though not always, be stopped by following the advice I received from Mrs. Diddell—to remove the affected spot and drop a few drops of copper sulphate solution on the soil and edges. Even worse, but fortunately less common, is a black alga which quickly turns the lovely green to slimy black! In theory, with 85 dishes planted, the loss of one or a few should not be cause for discouragement or sorrow, but in fact, it always seems to be the most-wanted or rarest one or the one of which the supply is exhausted that is affected!

TRANSPLANTING

For first transplanting the little patches from the dishes, the tool I find to be unintended but perfectly adapted for the job is an apple-corer. The shape of the sharp point is just right for digging around and lifting a small patch, the rounded back presses it into the soil, and then is neatly withdrawn, and the point again used to gently tamp bits of soil around the edge of the little circle of green and to smooth out the row. The job is done without ever a touch by fingers or thumbs; though "man's best tools", they are far too clumsy for this fairy-sized task.

WATERING

Depending on weather and temperature, these dishes need watering only every 10–20 days. The logic of "constant moisture" of clay pots standing in water is reasonable, but as pointed out, untidy. In order to have the neatness of the pyrex dishes I preferred to gamble on the correct amount of moisture. Sometimes, due to my absence or the pressure of duties some have become too dry but if watered in time the plants seem to recover. Although frequent advice is to keep them "very moist and humid" my experience and the advice from the University of Michigan is that to err on the dry side is much better than keeping them too wet. While in the dishes, watering is done with bottled distilled water; when first in the cases, with boiled water, and later, when they have reached the "uncovered" or "upstairs" stage, they are able to cope with water from the faucet.

At the present time I am experimenting by completely sealing several dishes. At planting time a small roll of floral clay was put around the rim of the dish and the cover pressed tightly onto it. These dishes show daily droplets of moisture on the cover. Other unsealed dishes planted at the same time have been watered three times.

This planting in rows, all in the same container rather than in separate pots or pans, seemed at first to be taking a desperate chance. Fungus or pest trouble of other sorts might destroy them all. But this has never happened—yet. Any such thing is promptly removed, as is most of the moss appearing while the ferns are small. Again, the watering is a guess and gamble but the layer of crushed stone at the bottom assures good drainage and with even fair judgment and a little planting experience there seems to be little danger of over-watering.

When the plants are large enough, watering is quickly

done with a bulb sprinkler. Before that it is done with a hand sprayer which gives a fog-mist spray.

FERTILIZING

As the ferns grow and the rows become crowded, it seems reasonable and right to give them an occasional lift with a weaker-than-usual solution of Rapid Gro or other safe fertilizer. This is done every 3 to 4 weeks.

LABELLING

Each planted dish is labelled, by printing in very small letters on a strip of paper, a strip narrow enough for scotch tape to cover it on all sides, to hold it securely on the dish and protect it from water.

At first, it was the intention to mark each row with small green plastic markers bought for the purpose. But finding these were impractical due to the difficulty of keeping them straight-up and to their illegibility through moisture and glass, there are no name markers to detract from the ferns. Instead, a written record is kept. A list of names of ferns in each row in each section is made and thumb-tacked to the inside of the handy broom-closet door. These dated lists must of course be changed each time there is an exodus or entrance of new plantings, but the old ones are kept, and form a good back-check when needed. Quite unscientific, the lists nevertheless quickly show the species planted, date of planting, source of the spores and (sometimes) the date of first germination and first transplanting. They show, for instance, that spores having 18 hours of artificial light germinate in 2 to 4 weeks, whereas those planted at the same time having only window daylight take a week to a month longer. In one year one planting kept under lights saved three to four months growing time, that is, ferns under lights were ready for transplanting at the same time as others planted four months earlier with no time spent under artificial lights.

KINDS OF FERNS GROWN

Never at one time, even with 85 dishes, is there room for all the kinds of ferns that I would like to grow. In some dishes there are spores from England and Europe, and others come from New Zealand; these are to be tested for hardiness if they reach maturity. In others are some from California and from the tropics, known to be unable to survive here without a greenhouse. And always in some dishes are hardy eastern ferns, more of which are wanted for the outdoor plantings at Fernwood.

With considerable satisfaction I can look at my dish of promising prothallia and two rows of small-sized *Asplenium pinnatifidum* and remember the time a few years ago that I paid $2.50 for one small specimen just "so I could see it," and later lose it too!

Last fall a friend sent a frond of the rare Hart's-tongue from a recently discovered station in Upper Michigan. Her husband had seen it while hunting and had wondered what it was. That it was picked was too bad, but that it was loaded with spores was wonderful. Right now, there is a whole crowded row of Hart's-tongue fronds about 2″ tall.

There is a little patch of a dwarf *Adiantum pedatum* found in the Olympic Mountains, in Washington, and not yet scientifically described, I believe. Spores from purchased plants produced prothallia and then plants which retained the dwarf size and proved to be hardy through our Michigan winters.

Just two plants of a crested Maidenhair spleenwort (*Asplenium Trichomanes*) developed from a sowing made from a bit of a frond sent me by Mr. Rugg along with many other kinds from England. But now there are several fronds heavy with sporangia, which will assure future plantings. And I might go on mentioning others as rare or as long-wanted.

Quite by accident, a rare back-cross hybrid of an *As-*

plenium appeared in one of the rows and was discovered by Dr. Wagner; it is soon to be described in the Journal. This gave rise to the hope of developing other hybrids. About 20 dishes have been planted with two species each in the hope of creating *Asplenium*, *Dryopteris*, or other hybrids that have rarely or never been found wild.

ULTIMATE DISPOSITION

It is not always easy to introduce these "greenhouse" ferns to the big world of the out-of-doors. This is usually done by carefully choosing the time (weather-wise), and planting them (in rows, again) in nursery beds or cold-frames, where they stay for the first winter. Here attention can easily be given to providing lath and cheese-cloth shade and to frequent watering at first and to winter-covering later. If they survive this ordeal, limestone rock-ferns can go into the steps and wall, and crested and frilled English ferns and others not native to the eastern woods can be added to those already planted by the steps. Wood ferns are added to the many already along our paths or stream edges.

There is another place at Fernwood to be wrested from nature's weeds and briars, where there will be room for an almost unlimited number of rock ferns (still my favorites) and others. When it materializes, there will be no ferns planted here except those raised from spores in the little back porch. It is going to be great fun to see how many there will be there, say in five years' time.

SPORE EXCHANGE

As mentioned above, the Spore Exchange of the American Fern Society was established only a few years ago, but in this short interval of time a creditable list of available kinds has been built-up. Officers and members of the Fern Society have been generous with time and effort to make contributions. Many friends not even members of the Society or knowing one fern from another have

sent fronds "with brown dots" from near and far vacation trips. However, in order to keep a supply of fresh spores of a number of species on hand this must be repeated year after year. We ask the continued cooperation of all in sending spores or fertile fronds to our Exchange, and also urge more members to request spores in order to grow them and thus to get some of the same pleasure that I have from cooperating with nature in her mysterious and magic plans as shown by the life-cycle of growing ferns.

FERNWOOD, ROUTE 3, NILES, MICHIGAN.

Observations on Cultivated Ferns. V. The Species and Forms of Nephrolepis

C. V. MORTON

Perhaps the commonest of all ferns on our porches and in our living rooms are the Sword-ferns or Boston Ferns, which belong botanically in the genus *Nephrolepis*. The wild plants of this genus occur naturally on the forest floors and as epiphytes on the trees in tropical forests, both in the Old World and the New. Like most tropical ferns they do not take kindly to cultivation in modern dry and hot apartments and houses and do best in greenhouses. Fortunately, a variety arose in cultivation spontaneously that behaves differently, and which can be grown successfully under adverse conditions along with assorted rubber plants, snake plants, and other long-suffering house plants; this is the Boston Fern, which is discussed below. Naturally, even the Boston Fern makes better specimen plants when grown in greenhouses or out-of-doors in moist, mild climates.

KEY TO THE SPECIES

Indusia round, or nearly so, with a narrow or closed sinus at the base, the sporangia spreading out beneath in all directions.

Blades attenuate to the base, the lower pinnae less than half as long as the middle, and rounded at apex rather than acute; largest pinnae rarely more than 5 cm. long.

1. *N. rivularis*

Blades only slightly or not at all narrowed to the base, the lower pinnae only a little shorter than the middle, and acute or acuminate like the middle ones; pinnae 7.5–20 cm. long.

Rhachis of blade copiously scaly, as are also the midribs and lower surfaces of the pinnae; pinnae always auriculate at upper base, usually rounded at lower base.

2. *N. hirsutula*

Rhachis and pinnae sparsely scaly or glabrate; pinnae mostly not auriculate, or if slightly auriculate at upper base then auriculate at lower base also ..... 3. *N. biserrata*

Indusia mostly reniform, with an open sinus at base, the sporangia mostly coming out facing the margins.

Fertile pinnae lobed, the sori borne on the lobes.

4. *N. acuminata*

Fertile pinnae entire, tothed, or variously divided, if lobed, the sori not borne on the lobes.

Plants producing small, scaly tubers on the stolons.

Pinnae oblong to linear ..... 5. *N. cordifolia*

Pinnae orbicular, often paired, always sterile. Blades often forking ..... *N. cordifolia* cv. 'Duffii'

Plants without tubers.

Pinnae small, mostly 1–1.5 cm. long, decidedly inequilateral at base, the superior base broad, auriculate, the lower base narrow and cuneate; blades always once-pinnate.

6. *N. pectinata*

Pinnae much larger, 3.5–8 cm. long or more, subequal at base, the lower base rounded, not cuneate; blades 1-5-pinnate, often highly irregular ..... 7. *N. exaltata*

1. NEPHROLEPIS RIVULARIS (Vahl) Mettenius. Vahl's Sword-fern.

This tropical American species is little known in cultivation; in fact, the only specimen that I have seen is from the New York Botanical Garden. It is similar to *N. exaltata* and probably has no advantage over that species as an ornamental plant. I know no cultivated variants.

2. NEPHROLEPIS HIRSUTULA (Forster) Presl. Rough Sword-fern.

In Standardized Plant Names, this species is called "Scurfy Sword-fern," which is also appropriate, although perhaps less likely to gain popular acceptance. The names are suggested by the abundance of brown scales on the axes and lower surfaces of the blades, these scales being much more abundant than in other species of *Nephrolepis*.

Strangely enough, although this species is not at all uncommon in cultivation, it is not mentioned at all in Bailey's Standard Cyclopedia of Horticulture, in Bailery's Manual of Cultivated Plants, or in Hortus II. Some of its varieties have been grouped erroneously among the varieties of the Boston Fern. It has passed in cultivation under various names, among them *N. floccigera* (Blume) Moore (a dubious species from Java and the Celebes Islands), *N. Zollingeriana* de Vriese, and various horticultural names, among them *N. Mayi*,[1] *N. Westonii*, and *N. superba*. The commonest variant, with close-set overlapping pinnatifid pinnae, is cv. 'Superba' (which has often been called forma *monstruosa*). The variant with forked pinnae is cv. 'Weston.'

3. NEPHROLEPIS BISERRATA (Swartz) Schott. Broad Sword-fern.

The common name "Broad sword-fern" has perhaps not beeen used before, but it seems appropriate, for this is the largest species and the one with the broadest blades, which are normally six inches broad or more, and may reach as much as a foot in width in wild plants al-

[1] According to Dr. R. C. Benedict, 'Mayi' is a dwarf type, slow in growth. He tells me that *N. hirsutula* was abundant in an earlier day with commercial florists. It often came up as a volunteer in greenhouses. The leaves grew rather erect, with recurved upper portions, like ostrich plumes. The upper sides of the leaves were characterized by a conspicuous covering of white scales. The plant was no good as a house plant.

though probably not often in cultivated ones. The name "Purplestalk sword-fern" proposed by Dr. Benedict in "Standardized Plant Names" is not appropriate, for the stalks are by no means purple, being mostly a rather dull brownish color and sometimes essentially straminеous.

This is perhaps one of the most widely distributed of all ferns, as it is usually interpreted. The original collection was from the island of Mauritius, in the Indian Ocean, but plants have been found throughout much of Africa, Asia, and tropical America. Although forming an obviously related group of plants, they are by no means uniform in general appearance or in minute characters, and it is likely that a monographic study would show that several species could be segregated. The plants from Florida and the West Indies in particular seem to diverge from the Mauritius type.

The only variation of *N. biserrata* known in cultivation is the Fishtail Sword-fern, which is called cv. 'Furcans,' in which the tips of the pinnae are forked, and oftentimes the two branches of the two forks are again forked. This is a desirable plant in cultivation. There appear to be two forms, a fertile one and one that appears to be always sterile; they have perhaps had a different origin. The sterile form often goes under the erroneous name *N. davallioides* cv. 'Furcans.'

Formerly, this species was known as *Nephrolepis acuta*, and it may still be found so listed in the catalogues of some nurseries.

4. NEPHROLEPIS ACUMINATA (Houttuyn) Kuhn. Java Sword-fern.

I have never had the pleasure of seeing this species growing, but it must make a beautiful display. In nature, it is an epiphyte growing on tree-trunks, with drooping fronds six or even eight feet long. Fertile specimens are easily identified by the position of the

sori—borne actually out on conspicuous lobes of the pinnae. Sterile specimens can be told by the blackish scales that are conspicuous along the rhachis; the rhachis-scales in other species are brown or pale.

In cultivation, this species has often passed under the synonymous name *N. davallioides*. Specimens with forked pinnae identified as this species have all turned out to be forms of *N. biserrata* rather than *N. acuminata*, going by the character of the scales mentioned above.

5. NEPHROLEPIS CORDIFOLIA (L.) Presl. Erect Sword-fern.

The common name proposed above is suggested by the erect habit of this plant, the fronds of which stand up like soldiers at attention, in contrast with the gracefully arching and spreading fronds of the Boston fern. The name "Tuber Sword-fern," suggested in Standardized Plant Names, is appropriate also, because this is the only species that bears "tubers," small potato-like growths that appear on the stolons some distance from the crown, and which serve as water-storing organs.[2]

The tubers are eaten to some extent in tropical America, or so I was told in Honduras, but the supply must be extremely limited. Because of the known poisonous qualities of many ferns, I should hesitate to recommend that anyone try them for lunch.

In the Los Angeles, California, area the Erect sword-fern is common in gardens, mostly in its typical form, but it can not be expected to thrive out-of-doors in most of the United States.

The most distinctive variant is cv. 'Duffii,' so different that one would hesitate to associate it with *cordifolia* at all, except that it produces the characteristic tubers. The pinnae are small, rounded at apex, and often prac-

[2] Dr. Benedict tells me that the form grown as 'Philippinensis' is indistinguishable from *cordifolia* except that it apparently does not produce tubers.

tically circular in outline; they are rarely more than a half-inch long. The fronds are almost always forking at apex, and are always sterile. It is a desirable plant for cultivation. It is common in tropical gardens throughout the world, and *may* sometimes have escaped from cultivation; at least, some herbarium specimens are labelled as though they had been collected in the wild.

This species has been known under the synonymous names *Nephrolepis tuberosa* and *N. cordata,* the latter probably just a misspelling.

A desirable, but probably rare, form is cv. 'Tessellata' with the pinnae pinnately divided above the middle, a synonym of which is probably cv. 'Plumosa.'[3]

6. NEPHROLEPIS PECTINATA (Willdenow) Schott. Basket-fern.

The name "Basket-fern" appears in Hortus II. It does not appear to me to be particularly appropriate, for this species is not as good for growing in baskets as the Boston Fern or some other species, such as *N. biserrata,* that grow naturally as epiphytes. *Nephrolepis pectinata* is naturally a terrestrial plant, and is the stiffest species of all. It was formerly thought to be only a variety of *N. cordifolia,* but it is definitely different. The most obvious character is found in the bases of the pinnae, which are acute at the lower side in *pectinata* and rounded or cordate in *N. cordifolia.* There are no tubers produced in *N. pectinata.*

This species, because of its rarity in cultivation, has not given rise to any cultivars.

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[3] According to a letter from Dr. Benedict, cv. 'Tessellata' was introduced by the H. B. May Company, Edmonton, England. He says that it seems to retain always its bipinnate division, unlike some bipinnate forms of the Boston Fern. He says also that it was common with dealers in years past, but was too slow growing to compete with the Boston Fern. It has spreading leaves, rather than stiffly erect ones like the type. The name 'Plumosa' was given by W. A. Manda.

7. NEPHROLEPIS EXALTATA (L.) Schott. Common Sword-fern.

The Common sword-fern is ascribed a world-wide distribution by most authorities although its actual range is perhaps more restricted. In cultivation, it is *not* common, being almost or entirely replaced by the following:

7a. NEPHROLEPIS EXALTATA var. BOSTONIENSIS Hort. Boston fern.

The origin of this, the commonest of all house ferns, is unknown. Its early history is discussed by Dr. R. C. Benedict.[4] Around 1896, it suddenly appeared among nurserymen's stock in Boston and Cambridge, where it was first identified as *N. davallioides* (i.e. *N. acuminata*), but was shortly thereafter referred to *N. exaltata* as a variety, where it has remained since. It is very like wild *exaltata*, except that it is not so stiff but laxer and more graceful and with somewhat broader fronds, but it behaves differently—it is sterile[5] and it is highly variable; natural populations of *N. exaltata* are uniform, at least locally, and are normally fertile from spores. The behavior of the Boston Fern suggests that it is possibly a hybrid, a sterile triploid, between *exaltata* and a second unknown parent. Still, hybridity alone would not quite explain the peculiar variations (sports) that have arisen from the Boston Fern. So far as I know, the cytology has not been carefully studied; it is a promising field for work, one not without difficulty however. Cytological studies in the ferns are mostly made with the spore-

[4] The Origin of New Varieties of Nephrolepis by Orthogenetic Saltation, I. Progressive Variations. Bull. Torrey Bot. Club **43**: 207–234. 1916.

[5] Dr. Benedict described a "var. *fertilis*" of the Boston Fern, the origin of which was unknown and also the cytology. It did produce many viable spores, but it was not a reversion to the wild form, because its progeny were highly variable, being variously cut, ruffled, and divided like other Boston Fern cultivars. It needs further investigation. Apparently, this fertile form was never in commercial cultivation; it may no longer exist or it may still be grown in the Brooklyn Botanic Garden.

mother cells, but most Boston Ferns are completely sterile and consequently some method for study of the somatic chromosomes would have to be devised. The small size and large numbers of the fern chromosomes render them difficult to study for technical reasons.

Over a hundred named cultivars of the Boston Fern have appeared within the last fifty years, most of them between the years 1900 and 1920. Interest in developing new kinds has waned in recent years, and but few of the older sorts are still widely grown. The typical Boston Fern is still the commonest, because it is the one that does best under conditions in the ordinary house or apartment; it will stand a good deal of abuse and neglect. The delicate, finely divided forms are more strictly greenhouse plants.

The principal authority on the Boston Fern and its variations is Dr. R. C. Benedict, who published a number of papers describing the variations, including the only systematic account that has been published (in Bailey's Standard Cyclopedia of Horticulture). These cultivars combine variation in several respects—division (from simply pinnate through pinnatifid, to bipinnate and on to 5-pinnate, sometimes with several kinds of division on one plant or even one frond), ruffling of the pinnae, forking of the blades and pinnae (sometimes several times), dwarfing (including diminution of the rhachis, with consequent imbrication of the pinnae), and others. Perhaps the most striking end-product is the form that has been called cv. 'Trevillian,' in which the division of the blade is so extreme, the shortening of the rhachis so pronounced, and the ruffling so accentuated that a single leaf appears to be just a green ball. Although this extreme form is not ornamental, it is still in cultivation. It developed a further peculiarity, unknown elsewhere in the genus *Nephrolepis*, of becoming proliferous, that is, of bearing vegetative buds on the rhachises, which serve to produce new plants. Strangely

enough, the plants arising from these buds (or gemmae) are not like the parent at all, but are simply pinnate and not ruffled, and represent a reversion to a more or less typical form of *bostoniensis*. Such reversions of the cut-leaved variants are not infrequent, and several types were described by Dr. Benedict. Some reversions are temporary and apparently seasonal, and others are permanent.[6]

Boston Ferns produce runners (stolons) from the bases of the leaves, which take root and form new plants. This is the standard method of propagation. After the new plants take root they are cut off from the runner and potted. A single Boston Fern can thus produce hundreds of progeny, most of which are quite like the parent plants, but occasionally one will be decidedly different, representing a mutation and a new cultivar, most of which are not improvements and which are discarded by growers.

A KEY TO THE PRINCIPAL CULTIVARS OFFERED IN THE TRADE AT PRESENT[7]

Blades simply pinnate, or at most with irregular lobes or forking pinnae.

Leaves of well-grown plants three feet long or more.

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[6] Dr. Benedict contributes the following note: Boston Fern varieties usually derive some of their most distinctive characteristics from three-dimensional features, both of whole plants and single leaves. Some of these features tend to disappear in pressed specimens, e.g., the concavity and slight arching of the pinnae of 'Scottii,' the ruffling of 'Mrs. T. Roosevelt,' and the "plumy" characteristics of 'Elegantissima-compacta' and 'Norwoodii.' Also, the most typical features of some forms may be obscured in some plants that have less than optimum growing conditions; thus 'Piersonii' may show no bipinnate leaves during the winter in the north. Another distracting characteristic is the tendency of the divided forms (but not the straight dwarfed or ruffled types) to produce reverted leaves, ranging from more or less typically divided to only once-pinnate; there may be thus produced a mongrel sort of plant that is incapable of giving rise to specimens of the typically divided type.

[7] Contributed by Dr. R. C. Benedict. Additional cultivars that are currently offered by dealers are 'Hillii,' 'Colorado,' 'Springfield,' and 'Hana' (an error for 'Nana'?).

Pinnae not lobed, nearly plane ..... var. bostoniensis
Pinnae lobed or forked.
Pinnae ruffled, with some lobing ..... cv. 'Mrs. T. Roosevelt'
Pinnae forking at tips ..... cv. 'Gretnae'
Leaves less than three feet long.
Pinnae plane or nearly so ..... cv. 'Dwarf Boston'
Pinnae ruffled ..... cv. 'Teddy Jr.'
Pinnae reflexed, the upper surface convex ..... cv. 'Scottii'
Blades two or more times pinnate, at least on most leaves.
Leaves over three feet long, essentially bipinnate.
Leaf tips and pinnae not forking ..... cv. 'Piersonii'
Leaf tips and pinnae forking ..... cv. 'Splendida'
Leaves less than three feet long.
Leaves essentially bipinnate-pinnatifid when well developed.
Leaf tips and pinnae forking ..... cv. 'Wicheri'
Leaf tips and pinnae not forking.
Leaves 12–18 inches long.
Leaves mostly less than 15 inches long.
cv. 'Elegantissima-compacta'[8]
Leaves somewhat taller, fuller ..... cv. 'Norwoodii'
Leaves less than 12 inches long; rhachis shortened, with congested pinnae ..... cv. 'Fluffy Ruffles'[9]
Leaves tripinnate or quadripinnate, with small segments.
Leaves tripinnate.
Leaves up to 18 inches long; pinnate and segments often crowded ..... cv. 'Whitmanii'
Leaves less than 18 inches long; pinnae and segments usually open ..... cv. 'Verona'
Leaves quadripinnate, usually less than 12 inches long.
cv. 'Smithii'[10]

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[8] Apparently in the trade as cv. 'Compacta,' which is probably the best name. The name 'Elegantissima-compacta' is not well formed; Dr. Benedict informs me that this plant is not a derivative of cv. 'Elegantissima.'

[9] Close to the older cv. 'Muscosa' but apparently not the same. R. C. B.

[10] Sometimes known in the trade as "Lace-fern."

Diplazium japonicum Naturalized in Florida

C. V. MORTON AND R. K. GODFREY

In January, 1957, the junior author, in company with Mr. Paul L. Redfearn, Jr., visited the region of Lake Talquin, in Gadsden County, Florida, and collected a fern that was not recognized at the time. It was growing abundantly in a narrow ravine in hardwood forest on a steep slope north of the lake. Specimens were submitted to the senior author, who identified it as *Diplazium japonicum* (Thunberg) Beddome, a species not previously known naturalized in the United States, although it is fairly well known in cultivation, especially in southern California. Mrs. Fay MacFadden has it growing in her fern garden in Los Angeles.

The only other *Diplazium* from the United States that is at all similar is *D. lonchophyllum* Kunze, which is known from a single locality in Louisiana.[1] It is a Mexican species, doubtless introduced in Louisiana, although Dr. Maxon did not reject entirely the possibility that it *might* be native. In the case of *D. japonicum*, there is no doubt but that it is introduced, even though it is growing in Florida in a distinctly rural area, isolated from any present-day farmhouses and eight to ten miles from the nearest town. It is distant about 200 yards across a forested area from a country road. Its abundance and luxuriance suggest a natural propagation regardless of how it might have come to be here in the first place.

In general appearance and cutting *D. lonchophyllum* is not dissimilar to *D. japonicum*, but it differs in numerous particulars. It can be distinguished immediately by its stalked rather than sessile lower pinnae, and by the smooth rather than scaly stipes and rhachises. The only other true *Diplazium* known from the United States is

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[1] Cf. Maxon, William R. *Diplazium lonchophyllum* in Louisiana. This JOURNAL 34: 21–24. 1944.

Diplazium japonicum. Adapted from M. Ogata, Icones Filicum Japoniae, Volume 3, Plate 115, 1930

D. esculentum, also an introduction,[2] which is utterly different; it is distinguished fundamentally by its anastomosing veins and its bipinnate division.

Of native species, *D. japonicum* most nearly resembles the Silvery Spleenwort, *Athyrium thelypterioides*, although the similarity is not close. The Silvery Spleenwort has many more pairs of pinnae, is much more delicate in general, and has smooth, rather than scaly rachises. The pinnae are deeply pinnatifid nearly to the costa, whereas those of *D. japonicum* are less deeply lobed.

E. B. Copeland, and some other modern fern students, have followed Milde in uniting the genera *Diplazium* and *Athyrium* under the latter name. Although it appears that there are no fundamental morphological differences between the two, most species can be readily placed in one or the other, and it seems advisable to retain the traditional division until a monographic study has been made. It seems as though true *Athyrium* has a different basic chromosome number ($n = 40$) from *Diplazium* ($n = 41$), but not enough species have been investigated from this point of view. Dr. Manton has indicated that *D. japonicum* has the number $n = 82$ (a tetraploid number). *Athyrium thelypterioides* is one of the species that is intermediate between *Athyrium* and *Diplazium*; apparently, a chromosome count has not been made.

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[2] Cf. Diddell, Mary W. *Diplazium esculentum* in Florida. This JOURNAL 38: 16–19. 1948.

Validation of Some New Combinations

MME. TARDIEU-BLOT

Article 32 of the International Code of Botanical Nomenclature (1956 edition) specifies that "A new transfer or combination published on or after 1 Jan. 1953 is not validly published unless the basionym (name-bringing or epithet-bringing synonym) is clearly indicated with a full reference to its author and original publication." Since 1953 I have proposed several new combinations without having properly cited the basionyms, in accordance with the above Rule. The present paper citing the basionyms will serve to validate these combinations.

ASPLENIUM AFFINE Swartz var. **Gilpinae** (Baker) Tard., *comb. nov.* (Tardieu, in Mém. Inst. Sci. Madagascar, Sér. B, **6**: 219. 1955; *op. cit.* **7**: 48. 1956, *sine basion.*)

Asplenium Gilpinae Baker, Journ. Linn. Soc. [London] **16**: 200. 1877.

ASPLENIUM HERPETOPTERIS Baker var. **acutipinnatum** (Bonap.) Tard., *comb nov.* (Tardieu, in Mém. Inst. Sci. Madagascar, Sér. B, **7**: 50. 1956, *sine basion.*)

Asplenium acutipinnatum Bonap., Not. Pterid **4**: 69. 1917 (*sphalm. acutipinnata*)

ASPLENIUM HERPETOPTERIS Baker var. **masoulae** (Bonap.) Tard., *comb. nov.* (Tardieu, *op. cit.* 50, *sine basion.*)

Asplenium masoulae Bonap., Not. Pterid. **10**: 182. 1920.

ASPLENIUM PELLUCIDUM Lamarck var. **dareifolium** (Bory) Tard., *comb. nov.* (Tardieu, *loc. cit., sine basion.*)

Asplenium dareifolium Bory ex Willd. Sp. Plant. **5**: 335. 1810.

ASPLENIUM VIVIPARUM (L.f.) Presl var. **daucifolium** (Lamarck) Tard., *comb. nov.* (Tardieu, *op. cit.* 47, *sine basion.*)

Asplenium daucifolium Lamarck, Encycl. Meth. **2**: 310. 1786.

ASPLENIUM VIVIPARUM (L.f.) Presl var. **inaequale** (Willd.) Tard., *comb. nov.* (Tardieu, *loc. cit.* 48, *sine basion.*)

Darea inaequalis Willd., Sp. Plant. **5**: 298. 1810.

ASPLENIUM VIVIPARUM (L.f.) Presl var. **lineatum** (Swartz) Tard., *comb. nov.* (Tardieu, *op. cit.* 47, *sine basion.*)

Asplenium lineatum Swartz, Journ. Bot. Schrader **1800**[2]: 51. 1801.

CORNOPTERIS **Boryana** (Willd.) Tard., *comb. nov.* (Tardieu, *op. cit.* 30, *sine basion.*)

Aspidium Boryanum Willd. Sp. Plant. **5**: 285. 1810.

CORNOPTERIS **Forsythii-majoris** (C. Chr.) Tard., *comb. nov.* (Tardieu, *loc. cit., sine basion.*)

Dryopteris Forsythii-majoris C. Chr. Dansk. Bot. Ark. [Pterid. Madagascar] **7**: 63. *pl. 16, figs. 1–3.* 1932.

CORNOPTERIS **Macdonellii** (Beddome) Tard., *comb. nov.* (Tardieu, *loc. cit., sine basion.*)

Asplenium Macdonellii Beddome, Journ. Bot. Brit. & For. **27**: 73. 1889.

CORNOPTERIS **oosora** (Baker) Tard., *comb. nov.* (Tardieu, *loc. cit., sine basion.*)

Nephrodium oosorum Baker, Kew Bull. **1896**: 41. 1896.

CORNOPTERIS **parvisora** (C. Chr.) Tard., *comb. nov.* (Tardieu, *loc. cit., sine basion.*)

Dryopteris parvisora C. Chr., Ark. för Bot. **14**, pt. 19: 5. *pl. 1, fig. 5.* 1916.

CORNOPTERIS **pterorachis** (Christ) Tard., *comb. nov.* (Tardieu, *loc. cit., sine basion.*)

Athyrium pterorachis Christ, Bull. Herb. Boiss. **4**: 668. 1896.

CORNOPTERIS **sulcinervia** (Hieron.) Tard., *comb. nov.* (Tardieu, *loc. cit., sine basion.*)

Aspidium sulcinervium Hieron. in Engl. Pflanzenw. Ost. Afr. **C**: 85. 1895.

CORNOPTERIS **tenuisecta** (Blume) Tard., *comb. nov.* (Tardieu, *op. cit.* 32, *sine basion.*)

Aspidium tenuisectum Blume, Enum. Pl. Jav. 170. 1828.

CORNOPTERIS **viridifrons** (Makino) Tard., *comb. nov.* (Tardieu, *op. cit.* 30, *sine basion.*)

Athyrium viridifrons Makino, Bot. Mag. Tokyo **13**: 15. 1899.

CTENITIS **arthrothrix** (Hooker) Tard., *comb. nov.* (Tardieu, Notul. Syst. **15**: 89. 1954, *sine basion.*)

Polypodium arthrothrix Hooker, Sp. Fil. **5**: 14. 1864.

CTENITIS **Boivinii** (Baker) Tard., *comb. nov.* (Tardieu, *op. cit.* **6**: 221. 1955, *sine basion.*)

Nephrodium Boivinii Baker, in Hook. & Bak. Syn. Fil. ed. **2**: 501. 1874.

CTENITIS **Warburii** (C. Chr.) Tard., *comb. nov.* (Tardieu, Notul. Syst. **15**: 89. 1954, *sine basion.*)

Dryopteris Warburii C. Chr. Dansk. Bot. Ark. **7**: 58. *pl. 14.* 1932.

CYCLOSORUS **silvaticus** (Pappe & Raws.) Tard., *comb. nov.* (Tardieu, Mém. Inst. Sci. Madagascar, Sér. B, **6**: 220. 1955, *sine basion.*)

Goniopteris silvatica Pappe & Raws. Syn. Fil. Afr. Aust. 39. 1858.

CYCLOSORUS SUBPENNIGERUS (C. Chr.) Tard., *comb. nov.* (Tardieu, *loc. cit., sine basion. et cum. auct.* "**Bak.**")

Dryopteris subpennigera C. Chr. Dansk. Bot. Ark. **7**: 52. *pl. 12, figs. 1, 2.* 1932.

DAVALLIA CHAEROPHYLLOIDES (Poir.) Steud. var. **mauritiana** (Hooker) Tard., *comb. nov.* (Tardieu, Notul. Syst. **15**: 178. 1956, *sine cit. et cum. auct.* "C. Chr.")

Davallia mauritiana Hooker, Sp. Fil. **1**: 164. *pl. 55B.* 1845.

HETEROGONIUM **cyatheifolium** (Desv.) Tard., *comb. nov.* (Tardieu, Notul. Syst. **15**: 89. 1954, *sine basion.*)

Polypodium cyatheifolium Desv. Prodr. 239. 1827.

HUMBLOTIELLA **odontolabia** (Baker) Tard., *comb. nov.* (Tardieu, Mém. Inst. Sci. Madagascar, Sér. B, **7**: 38. 1956, *sine basion.*)

Davallia odontolabia Baker, Journ. Bot. Brit. & For. **22**: 140. 1884.

POLYSTICHOPSIS **bella** (C. Chr.) Tard., *comb. nov.* (Tardieu, Notul. Syst. **15**: 270. 1956, *sine basion.*)

Dryopteris bella C. Chr. in Bonap. Not. Pterid. **16**: 164. *pl. 8.* 1925.

PSEUDOTECTARIA **crinigera** (C. Chr.) Tard., *comb. nov.* (Tardieu, Notul. Syst. **15**: 86. 1954, *sine basion.*)

Aspidium crinigerum C. Chr. in Bonap. Not. Pterid. **16**: 34. 1925.

PSEUDOTECTARIA **Decaryana** (C. Chr.) Tard., *comb. nov.* (Tardieu, *loc. cit., sine basion.*)

Tectaria Decaryana C. Chr. Dansk. Bot. Ark. **7**: 66. *pl. 19.* 1932.

SAMBIRANIA **Decaryana** (C. Chr.) Tard., *comb. nov.* (Tardieu, Mém. Inst. Sci. Madagascar, Sér. B, **7**: 36. 1956, *sine basion.*)

Schizoloma Decaryanum C. Chr. Dansk. Bot. Ark. **7**: 79. *pl. 28, figs. 1, 2.* 1932.

SAMBIRANIA **plicata** (Baker) Tard., *comb. nov.* (Tardieu, *op. cit.* 34, *sine basion.*)

Lindsaea plicata Baker, Journ. Linn. Soc. [London] **25**: 350. 1889.

SCHIZOLOMA **Chienii** (Ching) Tard., *comb. nov.* (Tardieu, Mém. Inst. Sci. Madagascar, Sér. B, **7**: 37. 1956, *sine basion.*)

Lindsaea Chienii Ching, Sinensia **1**: 4. 1929.

SCHIZOLEGNIA **leptophylla** (Baker) Tard., *comb. nov.*

Lindsaea leptophylla Baker, Journ. Bot. Brit. & For. **22**: 141. 1884.

Schizoloma leptophyllum Tard. Mém. Inst. Sci. Madagascar, Sér. B, **7**: 37. 1956, *non rite edit., i.e. sine basion.*

SCHIZOLEGNIA **oxyphylla** (Baker) Tard., *comb. nov.*

Lindsaea oxyphylla Baker, Journ. Bot. Brit. & For. **29**: 3. 1891.

Schizoloma oxyphyllum Tard. Mém. Inst. Sci. Madagascar, Sér. B, **7**: 37. 1956, *non rite edit., i.e. sine basion.*

The above two combinations follow Alston's segregation of the new genus *Schizolegnia.*

SPHENOMERIS **campylophylla** (Fourn.) Tard., *comb. nov.* (Tardieu, Mém. Inst. Sci. Madagascar, Sér. B, 7: 37. 1956, *sine basion.*)

Lindsaea campylophylla Fourn. Ann. Sci. Nat. [Paris] **18**: 335. 1873.

SPHENOMERIS **emirnensis** (Hooker) Tard., *comb. nov.* (Tardieu, *op. cit.* 36, *sine basion.*)

Davallia emirnensis Hooker, Sp. Fil. **1**: 189. 1845.

SPHENOMERIS **Goudotiana** (Kunze) Tard., *comb. nov.* (Tardieu, *loc. cit., sine basion.*)

Davallia Goudotiana Kunze, Analect. 35. *t. 22, f. 2.* 1837.

SPHENOMERIS **madagascariensis** (Baker) Tard., *comb. nov.* (Tardieu, *loc. cit., sine basion.*)

Lindsaea madagascariensis Baker, Journ. Linn. Soc. [London] **16**: 198. 1877.

SPHENOMERIS **microphylla** (Swartz) Tard., *comb. nov.* (Tardieu, *op. cit.* 37, *sine basion.*)

Lindsaea microphylla Swartz, Journ. Bot. Schrader **1800**[2]: 79. 1801.

MUSEUM NATIONALE D'HISTOIRE NATURELLE, 57 RUE CUVIER, PARIS, FRANCE.

Notes on Micronesian Pteridophyta, II.

F. R. FOSBERG

This series started in 1950[1] is continued in the present paper with observations on the genus *Ceratopteris* Brongn. (Parkeriaceae), of which two species have been found in Micronesia, one of them generally regarded as a local endemic in Guam.

CERATOPTERIS THALICTROIDES (L.) Brongn. Bull Soc. Philom. Paris (1821): 186. 1821.

This widely distributed species, usually found growing rooted in the muddy bottoms of rice and taro pits, has been known from Micronesia since Volkens reported it from Yap in 1901. Both Kanehira and Hosokawa added reports from Palau in 1935, with Hosokawa mentioning also Guam, probably basing this record on Safford's report in 1905. Hosokawa's specimen, no. *6858* (Fo), from Palau represents a very slender plant, with fertile fronds only, but is in all probability correctly referred to this species. Guam specimens from either Safford or Hosokawa have not been seen, but probably belong with the plants discussed as *C. gaudichaudii* below. To the records of true *C. thalictroides* may be added *Fosberg & Wong 25488* (US, BISH, Fo)[2] and *Lessa 97* (BISH), both from Mogmog Islet, Ulithi Atoll, Caroline Islands. This is a large robust plant, with fronds up to 45 cm. tall, which was growing in the water of a taro pit. The vernacular name recorded by Lessa is "walbwong."

CERATOPTERIS GAUDICHAUDII Brongn. Bull. Soc. Philom. Paris (1821): 187. 1821.

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[1] Fosberg, F. R. Notes on Micronesian Pteridophyta. Amer. Fern Journ. 40: 132–147. 1950.

[2] Herbarium abbreviations: US: United States National Herbarium; BISH: Bernice P. Bishop Museum, Honolulu; Fo: Still in author's hands.

This species was first collected in 1819 by Gaudichaud who wrote (translated) about it as follows:[3]

"It is at the edge of these humid gardens [irrigated rice, sugar-cane, and taro fields] and in the bottom of inundated plains that grows spontaneously *Ceratopteris gaudichaudii*, Ad. Brong. (oumoug-soussounian), an annual fern, tender, usefully employed as a salad . . . " And on p. 394: "This fern, which we believe to be annual, like its relatives, bears in Guam the name oumoug (houmoug) soussouniann (souzouniann); it grows abundantly in the marshy grounds where the river of Agaña has its springs. A field of black soil, compact, recently plowed, was then [May 1819] almost entirely covered with young specimens, still without fructifications, the state in which people search for this plant to eat it as a salad.

"Its leaves are fasciculate, of a tender meadow-green, very delicately herbaceous in texture, bipinnatifid, with linear lobes, in the axils of which can be seen small pale-yellow, bulbiform, glandular bodies, the flattened petioles bearing a few leafy, membranaceous, concave, cellular, diaphanous scales.

"In this plant, the veins or vascular bundles are capillary, 3 or 4 in number; they divide at the summit of the petioles and in the leaflets become reticulate after successive dichotomies. The branches of the frond give rise to ribbon-like segments or buds. The cellular tissue has a very large mesh."

From Gaudichaud's manuscript notebook, p. 159:

"83. Oumoug soussounian. This singular fern with leaves 3 times pinnatifid offers as characteristic its fertile leaves with a rolled edge, joined beneath, bearing a brown membrane containing globular fructifications which divide into an infinity of other globules equally round. *Pteris?* Base of pinnules of different order bearing a bulbiform, pale-yellow glandular-body Herbaceous

[3] Bot. Voyage Uranie 74. 1826.

plant, brittle, meadow-green. In all the humid fields that surround the springs of the river of Agaña.''[4]

Safford[5] gives the native name as ''umug sensonyan'' and probably knew the plant, but no collection of his has been seen. It was collected near the mouth of the Talofofo River in 1946 by Grether and again in 1954 by Fosberg.

Gaudichaud collected fairly abundant material [his no. 83] of which four sheets have been examined, two in Paris, one in Geneva, and one in Florence. The plant represented by these is clearly a rooted plant, small and delicate, the longest fertile frond being 18 cm. long. There is a complete transition from sterile fronds that are ovate with broad oblong somewhat dentate segments, through sterile fronds with much narrower, broadly linear segments, to narrowly triangular fertile ones with narrowly linear-acuminate segments. The longest frond is a fertile one 18 cm. long and 7 cm. wide, with a stipe 6 cm. long, and alternate pinnae, 4 on a side. The sterile fronds are smaller, up to 10 cm. long and half as wide, with 5 or 6 subopposite pinnae on a side, and stipes 2 to 3 cm. long. The type collection shows at most tripinnatifid fronds. The Fosberg collection (*35454* US, BISH, Fo), also rooted, is similar to the type, but shows some signs of a proliferation of small plants on the sterile fronds. The cutting of the fronds of these rooted collections is not essentially dissimilar to that of *C. thalictroides*, though more delicate than most material of that species. The Grether collection (*4326* US) is of floating plants, with fronds (up to 25 cm. long) conspicuously finely dissected (4–6 times divided), the segments being narrow and almost perpendicular to the rachises. This pattern is approached only by one collection of *C. thalictroides* exam-

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[4] I have to thank my colleague, Miss M.-H. Sachet, for translations of these items, and the authorities of the Museum d'Histoire Naturelle: Phanérogamie, Paris, for the opportunity to consult the manuscript field notes of Gaudichaud.

[5] Contr. U.S. Nat. Herb. 9: 222, 273. 1905.

ined, *Priest* in 1930 (US), from Hawaii.

Taro pits are few in Guam these days, as are rice fields. Wherever an opportunity was presented these were searched for *Ceratopteris* in 1950 and 1953–54, but with no success. The Grether collection was found floating in the estuary of the Talofofo River, several hundred meters above the mouth where the plants were said to be common. No plants were evident floating in this river in 1950 or 1953–54, though the river was examined for quite a distance. The plants of the Fosberg collection were found on the south bank of the Talofofo River about 300 meters above the mouth, growing sparsely on a small mud flat at the water's edge. The presence of a few plantlets on the fronds suggested that plants growing along muddy banks may be the source of the floating populations such as that collected by Grether. These must be swept out to sea during heavy rains such as those in December 1953, which cause a great rise in the river. The ecology of this species merits more careful study, preferably by those in a position to make repeated observations.

The existence of an endemic species of this genus on Guam must inevitably raise questions. It is apparently the only species in the genus with such a local distribution. This was considered so unlikely that Safford, followed by Merrill and Bryan, considered it identical with *C. thalictroides*. Christensen, in the Index Filicum, reduced all species of this genus, including *C. gaudichaudii*, to *C. thalictroides*. Wagner regarded it as distinct. There is no doubt that it is usually a smaller more delicate plant, with a slightly different range in cutting of the fronds. The sporangia are similar to those of *C. thalictroides* with many very narrow transversely elongate annular cells. The spores are similar, and have the same curious rugosity resembling the human epidermal ridges that make fingerprints. The differences are not impressive, and since the ancient Chamorros brought both rice

and taro with them from wherever they came they may well have brought *Ceratopteris* either deliberately or accidentally. It is conceivable that only a very small population was thus introduced, perhaps as small as one plant. This would drastically limit the potential variability of the descendants, and if the original stock were a dwarfed biotype this might account for the present characteristics of the plants under discussion.

It seems rather improbable that one would describe such a form as a species unless he found other correlated characters. However, since studies of the genus *Ceratopteris* are under way by Dr. Charles DeVol, it seems best to defer decision on the status of *C. gaudichaudii* until publication of his work.

U. S. GEOLOGICAL SURVEY, WASHINGTON, D. C.

Notes on the Distribution of Asplenium kentuckiense

W. H. WAGNER, JR.

The so-called "Kentucky spleenwort," *Asplenium kentuckiense*, is one of the rarest North American ferns. It is also one of the most interesting, because it now seems possible that it is composed of the germplasms of three entirely different species. On evidence from morphology and anatomy, it seems likely that this fern is a "compound," a blend of equal parts of *A. montanum*, *A. platyneuron*, and *A. rhizophyllum*.[1] Almost all plants of *A. kentuckiense* will probably be found to be sterile; but on theoretical grounds, at least, there is a definite possibility that a fertile population may sometime arise in nature, in which the chromosome number of the original sterile form (predicted to be 108) has become doubled (i.e., $2n = 216$). In his original description of *A. ken-*

[1] Wagner, W. H., Reticulate Evolution in Appalachian Aspleniums. Evolution 8: 103–118. 1954.

ASPLENIUM KENTUCKIENSE. A. B. MASSEY 2922, FROM NEAR CHATHAM, PITTSYLVANIA COUNTY, VIRGINIA, MAY 6, 1939

tuckiense, T. N. McCoy[2] listed several places where it had been collected, all of these in the state of Kentucky (Keyser Creek, Boyd Co.; Buzzard Roost, Calloway Co.; Rowan Co.). The purpose of this paper is to give data on the localities in states outside Kentucky.

Probably the finest and largest specimen of *A. kentuckiense* ever found was that of Mr. Floyd Bartley from the state of Ohio. It is in Mr. Bartley's private herbarium, but fortunately, Vannorsdall, in his recent book, "Ferns of Ohio,"[3] chose it for his illustration of the species, and published three plates (*figs. 51–53*) of the specimen at different magnifications. The specimen was discovered in 1946, growing near the base of a large sandstone cliff in Hay Hollow, Jackson Township, Pike County, Ohio. *Asplenium pinnatifidum* is abundant at this locality, and there are frequent plants of *A. platyneuron*.

In Illinois, the single known collection of *A. kentuckiense* was made by Franklin Sumner Earle, probably around 1880. It is represented by two detached but complete and readily identifiable leaves, mounted on a herbarium sheet with *A. pinnatifidum*. A tracing of one of these leaves and the veins and sori of a pinna from this collection are depicted in my article on Appalachian Aspleniums.[4] The data that appear on the specimen are all too typical of many plant collections made before the turn of the century, before higher standards of labelling became the custom. The label on the mixed sheet is woefully unhelpful: It is an old-fashioned printed label of "Illinois Flora," with the annotations "Asplenium pinnatifidum Nutt. Locality S. Ill. Collector Earle." That is all. The two leaves of this collection, incidentally, represent probably the first find of this species anywhere.

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[2] A new Asplenium from Kentucky. This JOURNAL, **26**: 104–105. 1936.

[3] Curtis Book Store. Wilmington, Ohio. 1956.

[4] *Op. cit.*

The specimens are in the Chicago Natural History Museum.

For the single Arkansas discovery of *A. kentuckiense*, we are indebted to Professor Dwight M. Moore, of the University of Arkansas, who found it some five or six miles south of the Missouri line in the northern part of Benton County. The habitat was sandstone ledges along Pea Ridge. Dr. Moore had gone to the locality to search for *A. pinnatifidum* in 1949. He has written (letter, October 9, 1953) that "It was while looking around at this time that I found on one of the ledges between plants of *A. pinnatifidum* and *A. platyneuron* a few plants that seemed to have characters of both of the species." A representative specimen from this locality is on deposit in the Herbarium of the University of Arkansas.

The single collection of Kentucky spleenwort known from Virginia was reported as *A. gravesii* by A. B. Massey.[5] The confusion of this species with *A. gravesii* is understandable because of their very subtle differences. The Virginia *kentuckiense* was taken in May, 1939 "2 miles west of Chatham, on a boulder in open woods near south shore of Moses Mill Pond on Cherrystone Creek," Pittsylvania Co. It was associated with *A. pinnatifidum*, and Mr. Thomas Darling, who visited the locality in 1951, reports "a little *platyneuron* in the locality." The specimen, which though small is complete and includes many fronds, differs from *A. gravesii* in tapering toward the base, the lowest pinna-pair being somewhat shorter than the two above it, and in its rather papery texture. *A. bradleyi* which, with *A. pinnatifidum*, forms the parentage of *A. gravesii* was not present at the locality. I am indebted to Mr. Darling and Conrad V. Morton for calling my attention to this collection.

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[5] The ferns and fern allies of Virginia. Va. Polytechnic Inst. Bull. 37: (no. 7) : 40. 1944.

Asplenium kentuckiense is thus known from five states —Kentucky, Arkansas, Illinois, Ohio, and Virginia. I am probably presumptuous in advising my colleagues on how to find new stations for this plant, since I have never succeeded in finding it myself. However, from the facts known at present and by analogy with other hybrids in this group, there are several pointers that may be of help. The first is that the best or optimum habitat for either parent (i.e., *A. pinnatifidum* or *A. platyneuron*) is probably less likely for *A. kentuckiense* than a habitat which lies between these extremes. *Asplenium pinnatifidum* is a strictly rock-inhabiting plant and it reaches its maximum development and abundance on rock cliffs; *A. platyneuron,* on the contrary, in spite of its common occurrence in rock crevices, tends to achieve its maximum development in soil. Where the two species are likely to grow close together or side-by-side will usually be the best habitat. An ideal situation, for example, might be a series of ledges in which *A. platyneuron* grows in soil at different levels, with *A. pinnatifidum* on the rock faces between. I believe that disturbed situations are especially good—where major disturbances by rock-slides, fires over the preceding decade, or a certain amount of cattle or sheep activities have produced a weedy and more or less barren condition. Here the plants of *A. pinnatifidum* may be "skimpy" and even the *A. platyneuron,* which commonly thrives under such disturbed conditions, may be somewhat dwarfed. In the field I have frequently heard such statements as "Not much point in looking for hybrids there among the weeds and briars. That slope is all weedy and broken up, and there are only a few plants [of whatever the participating parents are]." The fact is that such a spot might be exactly the best place to find the hybrid *A. kentuckiense.* These are only suggestions, but they may be helpful to field-workers looking for new localities.

UNIVERSITY OF MICHIGAN, ANN ARBOR, MICHIGAN.

Recent Fern Literature

"Plant Classification"[1] is a new textbook of systematic botany that can be highly recommended. All the families of ferns and flowering plants are discussed and illustrated in some detail, and there are instructive sections on the historical development and general principles of classification and nomenclature, on technical terminology, the use of keys and the general process of identification, and on methods of collecting and preserving plants. The special section on ferns and fern-allies occupies about 40 pages. Two new names are proposed as Divisions of the Plant Kingdom—Sphenophyta to contain the horsetails and Lycophyta to contain the club-mosses and quillworts. Although the work is designed for a beginner's course in college botany, the average amateur will find it readily usable.—C. V. MORTON

A KEY TO FERNS IN WESTERN NATIONAL PARKS.[2]—Keys to the eight families, 24 genera, and 106 species and varieties of ferns and fern-allies known to occur in the 16 western National Parks appeared in the July, 1954, issue of the American Midland Naturalist but have not as yet been noted in the Fern Journal.

The keys are constructed carefully, and for the most part contain sufficient information about specific characteristics to permit prompt identification of the species involved. In a few instances the key utilizes geographic localities instead of morphological characters to separate species. For example, the authors separate *Botrychium matricariifolium* from *B. boreale* with "Found in northern and central Colorado" in contrast with "Found in Alaska and the northern Rocky Mountains," respectively. Again, the leg of the key to *Cheilanthes parryi*

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[1] Plant Classification, by Lyman Benson, pp. 1–688. *illus.* 1957. D. C. Heath and Co., Boston, Mass. ($9.00).

[2] Bailey, Virginia L., and Harold E. Bailey, "A Guide to the Flowering Plants and Ferns of the Western National Parks." Amer. Midl. Nat. **54**: 1–32. 1954.

reads "Grand Canyon National Park," while that to the paired species, *C. cooperae*, is "Sequoia National Park." No descriptions are provided. Following the keys to the species within each genus, abbreviations indicate the park or parks in which each species occurs.

The recognition of species, subspecies, and varieties is liberal, *e.g.*, the authors accept *Equisetum limosum* and *E. kansanum* as distinct species, whereas conservative taxonomists often consider these two taxa either as synonyms or mere varieties or forms of *E. fluviatile* and *E. laevigatum*, respectively.

The July, 1954, installment is the first in a series designed to cover the entire vascular flora of the Western National Parks. A second part appeared in July, 1957.[2] The first installment, however, is the only one containing cryptogamic vascular plants. The first eight pages in the initial paper are devoted to an introduction and to a discussion of the vegetation of the Pacific Slope Region, the Rocky Mountain Region, and the Southwest Region, these being the phytogeographic areas recognized. The keys to the ferns occupy pages 9 through 23 in the initial paper. The remainder of this part, and all of the subsequent ones, cover the seed-bearing plants.

Part 1, in which the ferns and their allies are treated, will be interesting to members of the Fern Society who may have occasion to visit one or more of the National Parks west of the Mississippi River.—IRA L. WIGGINS, *Stanford University, Calif.*

Notes and News

OUR CHARTER MEMBER HONORED: The Council of the American Fern Society has unanimously voted to remit further dues for Miss Elmira Noyes, our one remaining Charter Member. Miss Noyes joined the Society in 1893, the year of its formation, and the Council thinks that 65 years is long enough for anyone to have to pay dues!

[2] *Op. cit.* **58**: 73–114. 1957.

Miss Noyes was a student at the University of Kansas of Prof. W. C. Stevens, who taught botany at the university for 51 years (1886–1937) and who died only two years ago. According to our former Treasurer, Dr. McGregor, Prof. Stevens remembered her very well. A portrait of Miss Noyes and some of her personal recollections of the early days of the Society were given in the article "Salute to Our Charter Members" by Dr. Correll.[1]

ANNUAL MEETING, 1958.—The annual meeting of the American Fern Society will be held this year on August 25 or 26, at the University of Indiana, Bloomington, Indiana, in connection with the meetings of the American Institute of Biological Sciences. We hope that members will prepare papers that they will read at the meetings. If a member is not able to attend in person, it will be possible to make arrangements to have papers read by others. Titles should be forwarded to the Secretary, Dr. Mildred Faust, as soon as possible, or at least prior to May 10.

ANNUAL SUMMER FIELD-TRIP, 1958.—This year the Fern Society will have its field-trip in southern Ohio and Indiana, a region containing a number of limestone outcrops and a good many rare and interesting ferns. Arrangements for the trip are being made by our Curator, Dr. Warren H. Wagner, Jr. (Department of Botany, University of Michigan, Ann Arbor, Michigan). The trip will probably be from about August 20 through 24. As usual, we will rely on private cars for transportation; we shall probably be able to get rides for those without cars. The cost will be kept to a minimum. Members who are at all interested in attending should get in touch with Dr. Wagner, so that he will have some idea of how many accomodations to book at the motels or hotels that we shall stop at.

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[1] This JOURNAL **43**: 137–149. *pl. 12.* 1953.

LETTER REGARDING MICROLEPIA STRIGOSA F. MACFADDENIAE.

November 6, 1957

Dear Mr. Morton:

The article you wrote in the July-September issue of the JOURNAL on Microlepias is interesting and enlightening. Just goes to prove that calling a fern by the wrong name for 30 years doesn't change the real name at all. The form *MacFaddeniae* that you describe has been grown by me and many of my friends here for 30 years or more under the name *Asplenium Sandersonii*. It is one that we all thought we knew. Our dealers here obtained it from a Mr. Baldwin in Pasadena, and that is the name he released it under. I don't know where he obtained it. I think Mr. Baldwin looked in Nicholson's Dictionary of Gardening or Schneider's Book of Choice Ferns at the illustration of *A. Sandersonii* (they both use the same one) and thought he had it.[1] So did we. I keep the long fronds picked out of f. *MacFaddeniae*, and so the frond stays quite long and narrow; but a neighbor of mine has let hers completely revert and it then *does* look like *M. strigosa*. It has never had spores, but if it does I shall send some.

Thank you for the JOURNAL. May I say that I enjoy each issue.

Sincerely,

Ora M. Wilson

American Fern Society

Report of the President for 1957

Several important changes in Fern Society affairs have been made during 1957. Owing to a reorganization of the American Association for the Advancement of Science, our Society has been given representation on

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[1] There is a casual resemblance between *Microlepia strigisa* f. *MacFaddeniae* and *Asplenium Sandersonii*, but it is only superficial. The latter is a true *Asplenium* and therefore quite unrelated to *Microlepia*. C. V. Morton.

their Council. By action of the Council of the American Fern Society, Dr. A. C. Smith, of the National Science Foundation, was appointed to represent our Society at the regular and special meetings of the Council of the A.A.A.S. He attended the regular meeting of the Council of the A.A.A.S. at Indianapolis in December, participated in the deliberations of that body, and forwarded a comprehensive report to the President in which he covered all actions that held even remote significance for the Fern Society.

During the spring of 1957, Dr. Rolla Tryon decided to move from the Missouri Botanical Garden to the University of California, so it became necessary to find a new depository for the Society's Herbarium and Library and to appoint a new Librarian and Curator. Dr. Tryon convinced Dr. W. H. Wagner, Jr., that the University of Michigan is conveniently and centrally located to a large proportion of our membership. He was successful, also, in getting Dr. Wagner to consent to being appointed Librarian and Curator of the Herbarium. The Fern Society's Council has now appointed Dr. Wagner Librarian and Curator of the Herbarium, so any member wishing to borrow specimens or literature dealing with ferns should, in the future, address his inquiry to Dr. W. H. Wagner, Jr., Department of Botany, University of Michigan, Ann Arbor, Michigan.

Mrs. Boydston continues to manage the Fern Society's Spore Exchange, and has done a "land office business" this past summer in sending out packets of spores. She has been a trifle less successful in getting a satisfactory supply of spores in exchange. Others can serve the interests of the Society by sending her packets of carefully collected spores or fragments of fruiting fronds.

An unexpectedly large increase in membership during the year, noted in the Report of the Secretary, necessitated another unusual action this past year. It was necessary to increase the total number of copies of the

FERN JOURNAL run off at each printing in order to fill the immediate demands and to provide a reasonable supply of unbroken sets of the Journal for future sale. Not only that, but we had to reprint two numbers, one and three of Volume 47, because the entire run of each of these numbers had been exhausted before the year was completed. These increases are no more than indications of healthy growth, provided we retain the majority of the new members a number of years and do not have too many drop out a year or two after joining!

Many of us were shocked when informed of Harold A. Rugg's death on February 13th, only a month and a half after he had become Vice-President of the Society. The vacancy in the Council left by Mr. Rugg's death was filled by appointment of Dr. Benjamin R. Allison, who consented to serve out the unexpired portion of the term. His willing and able help was most timely and greatly appreciated. He was particularly active in furthering the interests of the Fern Society in the New York metropolitan area, in planning and helping arrange field trips, garden parties, and lectures for Fern Society members and their friends.

Another member of the Fern Society, respected and loved by all who knew her, was taken by death in August of 1957. Mrs. C. A. Weatherby, who had been a member of the American Fern Society since 1914, had accompanied her husband on many fern hunting trips prior to his death in 1949. Together, they had made their home near the Gray Herbarium in Cambridge, Massachusetts, a mecca for all students of ferns and many who worked on the flowering plants. Even after Mr. Weatherby's death, his widow had opened her home to visiting botanists, and continued to show the kindly hospitality characteristic of these two gentlefolk. This writer holds very pleasant memories of the evenings spent with the Weatherbys in delightful historical spots around London, and of afternoons comparing notes with them at Kew Gardens,

during the summer of 1937. All who knew them were grieved when Mr. Weatherby died in July, 1949, and now we mourn the passing of his devoted and talented widow. It is characteristic of the generosity of Mr. and Mrs. Weatherby that Mrs. Weatherby's will provided a legacy in the amount of $3,000 for the support of the Fern Journal and other constructive uses of the American Fern Society. This fund will provide a small but regular income in support of the Fern Journal and possibly for other activities of the Fern Society. I am sure that Mr. and Mrs. Weatherby planned this course of action long years ago, because they clearly foresaw the help such a gift could afford our Society.

Membership increased from slightly below 600 to a few past 700 during 1957. Many of the new members joined the Fern Society directly as a result of an article on growing ferns from spores published in the August number of "Sunset," a West Coast magazine devoted to beautification of the home, gardening, travel, and recreation out of doors. We appreciate tremendously the boost given us by the publishers of "Sunset"! A good many other new members were won through the enthusiasm of members who had joined somewhat earlier —from a year to over fifty years earlier! These staunch supporters of the Society and its objectives deserve much credit, and sincere thanks are extended to them. The Editorial Board earnestly hopes that the pages of the American Fern Journal will interest and stimulate our new members, and that they will continue for many years to study, grow, and enjoy ferns.

One of our members who participated in the Annual Foray from August 21 through the 25th has prepared a report, to be published separately, on that activity. Following the Foray, a series of papers was presented during two half-day sessions on August 26th, in conjunction with the annual meetings of the American Institute of Biological Sciences, held on the Stanford Uni-

versity campus. Thirty-eight individuals attended the morning session and fifty-two were present during the afternoon. Thirty-five members and friends enjoyed an informal buffet luncheon during the noon-hour break between the two sessions. A number of those attending the Fern Society meeting on Monday remained throughout the next two or three days to hear papers presented by members of other organizations.

The reports prepared by the Secretary and by the Treasurer indicate that the American Fern Society is in a healthy condition, and that our regular financial reserves have risen slightly during the year, in spite of the slightly increased expenditures.

I take particular pleasure in thanking all of the officers, editorial staff members, curators, and librarians for their splendid cooperation and for their individual efforts in forwarding the interest of the American Fern Society during 1957. The Treasurer and the Editor-in-Chief have worked the hardest and most continuously, and I am particularly grateful to both of them. I am sorry that Dr. McGregor has found it necessary to terminate his stewardship as Treasurer, but wish him pleasant experiences during the sabbatical year he is planning when his current school year is finished.

Those who have served on regular and special committees and in numerous other ways deserve commendation, and such is gladly given. To each member goes my personal appreciation for entrusting me with the office of president for yet another year. The honor is accepted with humility and with the hope that 1958 will witness further improvement in Fern Society affairs.

Two new officers, Vice-President, James E. Benedict, Jr., and Treasurer, Dr. Walter S. Phillips, are welcomed heartily to the Council. May they enjoy the duties of their respective offices and gain valued friends among the members of the Society.

Perhaps, since the annual meetings of the A.I.B.S. are

to be held in Bloomington, Indiana, from August 24–28 in 1958, a larger percentage of our membership can attend than was able to get all the way to the Pacific Coast in 1957. If so, I feel sure that officers and members alike will enjoy the fellowship afforded by the Foray and the formal part of the meetings that follow.

But whether all officers reach Indiana or some are prevented from attending, each set of officers is temporarily entrusted with the affairs of the Society—the members constitute that Society and give it continuity, character, and life. May each member, and the American Fern Society as a whole, experience an excellent year during 1958.

Respectfully submitted,
IRA L. WIGGINS, *President*

Report of the Curator and Librarian for 1957

This was a year of major changes. The American Fern Society's Herbarium and Library were transferred from the Missouri Botanical Garden to the University of Michigan Department of Botany in August, 1957. The previous Curator and Librarian, Dr. Rolla Tryon, organized the materials with his typical care and forethought; and a total of 32 boxes (Merrill boxes) of pteridophyte specimens and 11 boxes of books were received at the University of Michigan, Ann Arbor, on August 12. The books were arranged on shelves in cabinets with glass doors, and the specimens were distributed in two single-door steel cabinets (Chas. Lane & Co.) in room 3010, Natural Sciences Building. The first loan issued from the Library was on November 23, the *British Fern Gazette* to Mr. Dale J. Hagenah of Birmingham, Michigan. Thus far no loans have been requested from the Herbarium, although several of the advanced graduate students at the University of Michigan have consulted the collection in connection with special problems.

One of our pleasant prospects for the enrichment of the Society's Library is Dr. Edgar T. Wherry's plan to

contribute a large number of his photographic negatives of ferns, some of these representing rare species. We have received news that Dr. Wherry also plans to contribute a number of fern specimens to the Herbarium.

The first and most important thing that I, as the new custodian of these collections, can do upon assuming the duties of this office is to express my gratefulness, and that of the American Fern Society, to my predecessor, Dr. Tryon, for the excellent state of the materials and for the fine manner in which he carried out his job.

Respectfully submitted,

WARREN H. WAGNER, JR., *Curator and Librarian*

Report of the Treasurer for 1957

At the end of the year our financial condition was a little better than in 1956. This was due to a significant increase in new members, the 87 sustaining members, the sale of back volumes, and gifts to the Society. The cost of handling the Society's business remained nearly the same though the increased activity of the year caused a slightly higher expenditure. A 3% increase in the cost of printing was offset by a reduction in the size of the JOURNAL from 176 pages to 168 pages. No funds were withdrawn from the three reserve accounts.

After four years as Treasurer of the American Fern Society, I wish to thank the many individuals who cooperated so completely. It has been a pleasure to work with the officers and members to further the study of ferns.

Receipts

	Amount	*Total*
Cash on hand, Jan. 1, 1957		$1,600.15
1956 Membership Arrears	$ 10.00	
1957 Membership Renewals	712.15	
1957 Sustaining Members	435.00	
1957 New Members	240.78	
1957 Subscription Renewals	80.60	
1958 Subscription Renewals	273.55	
Life Membership	50.00	
Sale of Back numbers	174.34	

Sale of Reprints	194.44	
Advertising	60.00	
Gifts	168.64	
		2,399.50
		$3,999.65

Disbursements

	Amount	*Total*
A. F. J. Vol. 46, No. 4	443.53	
A. F. J. Vol. 47, No. 1	480.28	
A. F. J. Vol. 47, No. 2	393.51	
A. F. J. Vol. 47, No. 3	412.33	
Reprinting Vol. 1, No. 3 A. F. J.	65.00	
Reprints	183.49	
Envelopes and Mailing A. F. J.	78.73	
Expenses		
President	112.90	
Secretary	33.76	
Treasurer	96.21	
Editor	21.09	
		2,320.83
Cash on hand, January 1, 1958		$1,678.82

STATEMENT DECEMBER 31, 1957

Assets

Cash on hand	$1,678.82
Bissell Herbarium Bequest	648.40
Life Membership Fund	744.45
Reserve Fund	1,774.88
Inventory A. F. J.	3,313.70
A. F. S. Library	396.00
	$8,556.25

Liabilities

Capital Account	$6,350.99
Suspense Credit, 1958 Subscriptions	273.55
Distribution, Vol. 46, No. 4, A. F. J.	538.86
Bissell Herbarium Fund	648.40
Life Membership Fund	744.45
	$8,556.25

Respectfully submitted,
RONALD L. MCGREGOR, *Treasurer*

Report of the Auditing Committee

We hereby certify that we have seen the books and accounts of Dr. Ronald L. McGregor, Treasurer of the American Fern Society, Inc., and have obtained confirmation of the correctness of the Society's balances on hand as set forth in detail in the accompanying report of the Treasurer.

Auditing Committee
W. H. HORR
ELLEN S. DUNCAN

Report of the Secretary for 1957

The membership has continued to increase, now totaling 709 as compared with 582 at the end of 1956. California is far in the lead of all other states with a total of 125 members.

Two honorary members were elected during the year: Dr. Ralph C. Benedict, a past-President of the Fern Society, and Dr. Irene Manton, of Leeds University, England.

We regret to report the deaths of the following membeds: Mr. Alfred T. Beals (1949), Mrs. Dudley Clapp (1953), Mr. Otto C. Risch (1956), Mr. Harold G. Rugg (1906), the Vice-president, and Mrs. Charles Weatherby (1914).

In the afternoon of June 22, Mr. and Mrs. Thorlief Fliflet and their family entertained the society in their lovely garden and home at Mountain Lakes, New Jersey. Mr. Fliflet has reported on this in number three of the JOURNAL. The many species of ferns are beautifully arranged.

A New England Field-trip in the vicinity of Rutland, Vermont was held July 12 and 13; this was reported on by Anna Scudder in number four of the JOURNAL.

The annual summer Foray of the Society was lead by Ira Wiggins and Conrad Morton. Mrs. Dorothea Luhr is reporting the details of the trip in this number.

The Annual Meeting was held on the campus of Stan-

ford University, August 26, in connection with the A.I.B.S. meeting. The morning meeting, presided over by Mildred E. Faust, consisted of the following papers: "An Amateur Plants Fern Spores" by Kathryn E. Boydston; "Factors in the Collection, Propagation, and Culture of Hardy Ferns," by Harry K. Roberts; "Cultivated Ferns of Southern California," by Barbara Hoshizaki; "Notes on Some Mexican Ferns," by A. J. Sharp (read by title only); "The Discovery of Hymenophyllum," by Herman Persson; "Microscopic Fern Studies," by Clara Hires; and "The Problems of *Polypodium virginianum* L." by Irene Manton, (read by title only; published in number four of the JOURNAL).

At 12:15 an informal luncheon, presided over by President Wiggins, was attended by 35 members.[1]

The afternoon session, presided over by Ira L. Wiggins, consisted of the following papers: "Peruvian Ferns," by Rolla M. Tryon; "Distributional Notes on Some Oklahoma Ferns," by George J. Goodman; "Survival of Hart's-tongue Fern in Central New York for 150 Years," by Mildred E. Faust; "Collecting Ferns in British Columbia," by Fay A. MacFadden; "A Conspectus of the Pteridophytes of British Columbia," by Thomas M. C. Taylor; and "Ferns and Fern Allies in Marin County," by John T. Howell.

An Exhibition and Demonstration Room was open for the Society during the entire convention period. Herbarium specimens and living material of characteristic California ferns and exotics growing in the region were

---

[1] Among Fern Society members and friends attending the luncheon were: William H. Baker, N. Floy Bracelin, Lincoln Constance, Delzie Demaree, Mildred E. Faust, Barbara Joe Hoshizaki, Takashi Hoshizaki, J. T. Howell, Marcel E. Juilly, Sylvia B. Leatherman, Elbert Little, Fay A. MacFadden, Elizabeth McClintock, C. V. Morton, Herman Persson, Walter Phillips, Lea Reed, Mr. & Mrs. Harry K. Roberts, Lewis Rose, William E. Schmidt, Eva Sobol, Harold L. Swendsen, Lucile Evans Swendsen, T. M. C. Taylor, Alice Tryon, Rolla M. Tryon, Ernest Twisselmann, Ira L. Wiggins, and Ora M. Wilson. The list is not complete.

displayed by the California members, as well as a large collection of photographs and models of fern spores of Clara Hires. Dr. and Mrs. Tryon displayed specimens and photographs of ferns with which they have worked.

All the members who attended realized and appreciated the fact that the success of the entire program was due in great part to the efficient planning of our President, Dr. Ira L. Wiggins.

Respectfully submitted.
MILDRED E. FAUST, *Secretary*

Report of the Judge of Elections

The results of the balloting for officers of the American Fern Society are as follows:

For President	
Ira L. Wiggins	328
Clair Brown	1
C. V. Morton	1
For Vice-President	
James E. Benedict, Jr.	327
Thomas Darling, Jr.	1
For Secretary	
Mildred E. Faust	327
For Treasurer	
Walter S. Phillips	326

I therefore declare the following candidates elected to the several offices: President, Ira L. Wiggins; Vice-President, James E. Benedict, Jr.; Secretary, Mildred E. Faust; Treasurer, Walter S. Phillips.

Respectfully submitted,
R. C. LOMMASSON, *Judge of Elections*

Report of California Field-trip

An enthusiastic group of members of the American Fern Society, most of whom were attending the annual meeting of the American Institute of Biological Sciences at Stanford University, spent five profitable days, August 21–25, 1957, on a foray to Mendocino and Humboldt

CALIFORNIA FIELD-TRIP, 1957. LEFT TO RIGHT. BACK ROW: SYLVIA LEATHERMAN, CONRAD MORTON, MILDRED FAUST, FAY MACFADDEN, MRS. BROWN, J. R. ROGERS, MRS. ROGERS, ORA WILSON, EVA SOBOL; LOWER ROW: IRA WIGGSIN, CLAIR BROWN, FRIEDA WERTMAN, DOROTHEA LUHR, BARBARA JOE, DONALD HUTTLESTON, CLARA HIRES, SARAH BROWN, BETSY ROGERS. PHOTOGRAPH BY DORCAS BROWN.

Counties in the area north of San Francisco. The entire trip was planned and led by Dr. Ira L. Wiggins, Director of the Natural History Museum, Stanford University, who had carefully located the ferns to be studied. The group was most congenial and the plans were smoothly carried out.

The caravan, comprising six cars and eighteen adults, left the campus at eight o'clock and proceeded north on Highway 101, which includes the Redwood Highway. At no time were we more than 35 miles from the ocean. We reached Eureka, a distance of 284 miles from San Francisco, the second day.

Willits was our stop early in the afternoon of the first day. Here we were met by Donald Branscomb, a fern lover and a member of the Fern Society, who knows the location of the wild ferns of the area and is successfully cultivating many varieties. On a rock formation in a canyon of Big Horn Ranch he showed us two small clusters of *Cheilanthus interexta* in dry condition due to the lateness of the season. *Cheilanthus gracillima* and *Polystichum munitum* var. *imbricans* were also seen in location and we then were shown Mr. Branscomb's splendid private collection. Outstanding were *Adiantum* × *Tracyi*, *Polystichum californicum*, *P. Dudleyi*, *Polypodium Scouleri*, *Woodwardia fimbriata*, and several species of *Pellaea*, *Notholaena*, and *Cheilanthes*.

That evening we had an unusually clear view of the comet Arkos.

Thursday morning we were taken on a tour of a mill on the outskirts of Willits, where Douglas fir is used in the manufacture of plywood. Five and a half miles north of Laytonville *Pilularia americana* sporocarps (with a few live fronds) were found in a bog. A short stop for lunch was made at Richardson's Grove, in the midst of the growth of the giant California redwoods. Further north we visited the Jewel Shop where native

Fern Canyon, near Prairie Creek State Park, Humboldt County, California, August, 1957. Photograph by Clair Brown

ferns are sold. However, the selection was small as many buyers had depleted the stock. At the beautiful Garden Club Grove, less well known and less crowded than Richardson's, were found *Athyrium Filix-femina, Pteridium aquilinum* var. *pubescens, Polystichum munitum, Polypodium Glycyrrhiza, Adiantum pedatum, Woodwardia fimbriata*, and *Dryopteris arguta*. Near Pepperwood, we saw huge plants of *Polystichum munitum* and *Athyrium Filix-femina*. The night was spent in Eureka.

On Friday, August 23, we headed north to Prairie Creek State Park in the northwest corner of Humboldt County, following the spectacular Coast Highway. Specimens of *Blechnum spicant, Dryopteris arguta, D. dilatata, Athyrium Filix-femina, Adiantum pedatum, Polystichum munitum, Polypodium Scouleri*, and *Woodwardia fimbriata* were found here, and again our photographers and spore collectors were busy. Then, instead of taking the four and a half mile hike through the Park to Fern Canyon, we drove over the mountains past several saw mills and approached it from the sea. A magnificent stand of *Adiantum pedatum* covers the walls of the cork-screw shaped canyon, which even in late summer were dripping with moisture. On the return to our motels a very small clump of *Lycopodium inundatum* was discovered by Dr. Wiggins at Big Lagoon State Park and nearby in the tall grass seven specimens of *Botrychium silaifolium* were found and photographed. This night also was spent in Eureka. Incidentally, fish dinners and a smorgasbord were enjoyed on the nights we spent there.

Early on the morning of August 24, Mr. and Mrs. T. J. Nunan, of Eureka, showed us their garden, which contains not only ferns, but many rare begonias, geraniums, and other plants. Several unusual, very fine-leaved species of *Adiantum* were observed. The mild climate

of Eureka makes outdoor culture of many plants possible, with roof protection in the summer and hangings on cooler winter nights.

Heading south, Founders Grove, containing the tallest known living redwood tree, was visited. *Adiantum Jordanii*, *Pityrogramma triangularis*, and *Selaginella Wallacei* were examined on rocks along the Eel River, on the outskirts of Leggett. Willits again became our stop for the night.

An early start on Sunday, August 25, brought us back to Golden Gate Park, in San Francisco, soon after noon. Here we had our last meal together in a picnic grove. After going through the conservatory, we carefully examined two tree ferns, *Alsophila excelsa* and *Dicksonia antarctica* in Tree Fern Grove.

Those making all or part of the trip were: Mr. & Mrs. Donald Branscomb, Dr. and Mrs. Clair A. Brown, and daughters Misses Sarah and Dorcas Brown, Dr. Mildred E. Faust, Miss Clara S. Hires, Mrs. Barbara Joe Hoshizaki, Dr. Donald G. Huttleston, Mrs. Sylvia Leatherman, Mrs. Dorothea Luhr, Dr. and Mrs. R. C. Lommasson, and Beth, Carol, Paul and Tim Lommasson, C. V. Morton, Mr. & Mrs. T. J. Nunan, Mr. and Mrs. J. R. Rogers, Timmie Rogers, Miss Eva Sobol, Mr. and Mrs. Harold L. Swendsen, Mrs. Frieda Wertman, Dr. Ira L. Wiggins, and Mrs. Ora Wilson.—DOROTHEA LUHR.

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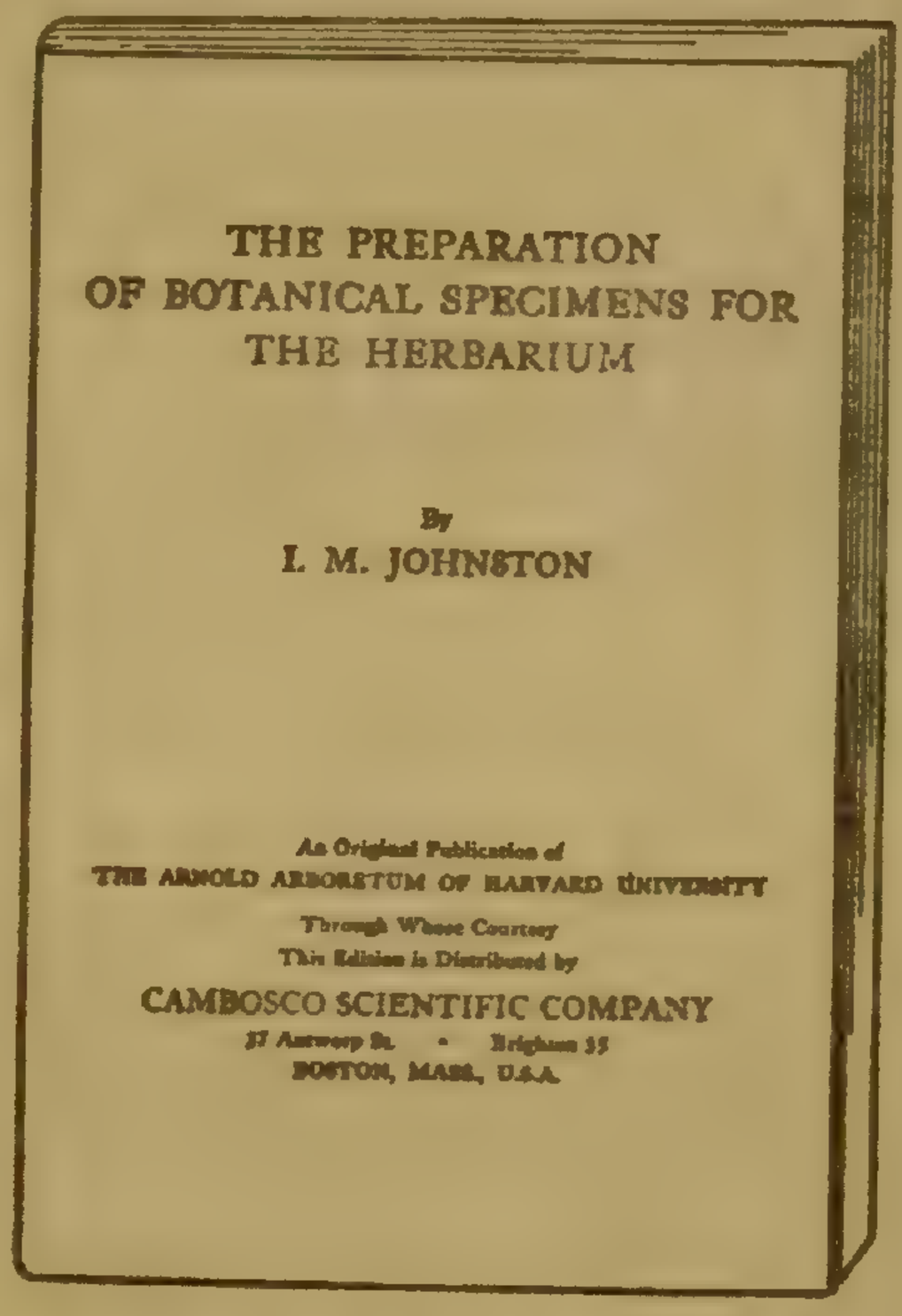

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A QUARTERLY DEVOTED TO FERNS

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AMERICAN FERN SOCIETY

EDITORS
C. V. MORTON
R. C. BENEDICT IRA L. WIGGINS
A. C. SMITH

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American Fern Journal

VOL. 48 APRIL–JUNE NO. 2

Ferns as a Hobby in Southern California

R. C. BENEDICT

For some years, it has been a matter of interest to me to note in each issue of the Fern Journal the increasing numbers of new members with California addresses. As long ago as 1953, Matt Mann, the Treasurer of the Fern Society, called attention to the fact that the California membership had grown until its list was second only to that of New York. By now it must have taken the lead.

During the last year or two, Mr. Morton's articles on cultivated fern species, with their frequent references to southern California fern gardens, have cast some light on the reason for the rapid growth. It remained, however, for a recent four weeks visit to that area, with the much appreciated help of a number of local members, to make clear to me the extensive and growing interest on the part of dwellers in what local newspapers refer to as "The Southland." The climate of California, as far north as San Francisco, is conducive to year-round gardening. Daffodils bloom in January, at least in areas not too far from the coast or too high in altitude. Roses bloom the year-round. Apparently, almost every home owner is garden-conscious, and the interest is not merely in a few flower beds but in broader landscape effects. Ferns, I was informed by one adviser in interior and exterior decoration, are essential to provide finely divided foliage, as an offset to the plainer and coarser patterns of philodendrons and so forth. Nurserymen abound. In the yellow pages of one of the five or six large telephone books which are necessary to cover the sprawling metrop-

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olis of Los Angeles, I counted upwards to one hundred nurserymen, and that number would have to be multiplied a good many times to cover all the local retailers that might be expected to offer at least some fern plants. Even the giant food-markets have their plant sections with ferns; I saw Boston Fern sports, small tree-ferns, and others in Ralph's Market, one of the large local concerns.

Because of the mild climate of much of California, it is possible to grow outdoors a wide range of fern species from subtropical regions. The fern gardener in one of the eastern states counts himself fortunate if his state offers as many as forty hardy species, but the southern Californian makes use of a present list said to number about 140 species, and that number could easily be multiplied several times by the introduction of appropriate species. This section of California has an advantage, as I later learned, over portions of the states bordering the Gulf of Mexico where mild winter temperatures also prevail but where with intense summer heat there are also heavy, driving rainstorms, a combination hard on delicate fern foliage.

Besides the general interest in a wide variety of fern species, there is also the collector's interest shown especially for platyceriums or staghorn ferns. At one small private garden in Ventura, the lady of a house where begonias had held sway reported that her husband agreed they might get one staghorn. Thereafter, he caught the fever and now they spend every available period scouting hundreds of miles to add additional species of this genus.

While most of the fern species in wide use are much less striking and distinctive than the staghorns, small and large fern plantings present unfamiliar aspects to a visitor from the East. Most similar, perhaps, is *Polystichum setosum*, which looks enough like *P. Braunii* to show its

relationship. Familiar from their wide use by eastern florists are various species of brake (*Pteris*) and the holly fern (*Cyrtomium*). Public parks and some small gardens have their representation of tree-ferns, mostly of Australasian origin, but an Hawaiian tree-fern species, *Cibotium Chamissoi*, has been abundantly imported in dormant, rootless condition. I met some difference of opinion as to the permanent establishment of these trunks, but I saw a number that seemed to be thriving after years in the same place. At one grower's, these trunks were on sale at prices proportional to their length—a 1½ foot specimen could be bought for $1.50 but the per-foot price increased for longer trunks. The same grower had a splendid, long-established specimen of *Dicksonia antarctica,* with a 10-foot trunk and more than 100 leaves; the price, admittedly designed to make its sale unlikely, was $450.00.

Interest in ferns is not confined merely to individual gardeners and garden clubs. The City of Los Angeles has taken official cognizance of a feature of its large Griffiths Park—a winding valley known as the Fern Dell. One of our members, Dr. W. C. Drummond, has official recognition as in charge of the continued improvement of the plantings. Dr. Drummond is preparing an account of the Fern Dell for the Journal.

Eastern fern hobbyists, with their climate-limited period and range of fern garden activity may well feel a touch of envy of an area where the opportunities are so much wider. Some of these newly established California ferns are familiar as house fern types for eastern indoor growth—*Cyrtomium, Pteris* species, and others. One which is rarely seen in the East but which can make a good house plant is the "mother fern" or "mother spleenwort," *Asplenium bulbiferum,* with its finely cut leaves, and copious production of small plants on the older leaves.

PILOT KNOB, NEW YORK

Is Equisetum laevigatum a Hybrid?

RICHARD L. HAUKE

The genus *Equisetum* is an ancient one, having possibly the longest fossil record of any extant genus of plants. There are about 20 living species throughout the world, but the specific differences are often subtle and the species tend to run together. An example is *E. moorei* of Europe, also called *E. hyemale* var. *schleicheri* and *E. intermedium* (of Schur, not Rydberg), which is intermediate between *E. hyemale* and *E. ramosissimum* and seems to intergrade into both. Manton, 1950, showed cytological evidence of the hybrid nature of this European species, as well as of *E. trachyodon* and *E. litorale*, both of which had been previously suspected of being hybrids. She wrote: "The detection of three species hybrids among little more than a dozen representatives of the genus is a surprisingly large number, especially when the rarity of prothalli is remembered, and it suggests fairly clearly that speciation can still occur."

In 1952, while attempting to identify the representatives of the genus *Equisetum* in northern Michigan, I became quite interested in the sect. *Hippochaete*, or scouring rush group, and have since adopted it as my doctoral thesis problem. Within this section there are several species that have been troublesome, including *E. laevigatum*. Part of this species was segregated into *E. hyemale* var. *intermedium* by A. A. Eaton, and called this because it was intermediate between *E. hyemale* and *E. laevigatum*. Schaffner later segregated those members of *E. laevigatum* with annual stems and blunt strobili as a new species, *E. kansanum*. Looking for additional characteristics by which to differentiate between these two species, I mounted their spores, and was greatly surprised to discover that all specimens from this area of Michigan that fit the description of *E. laevigatum* as

delimited by Schaffner have abortive spores, whereas those specimens that fit his description of *E. kansanum* have good spores. It is rather disturbing to think that such a widespread and common species as *E. laevigatum* might be of hybrid origin, so I sought further evidence

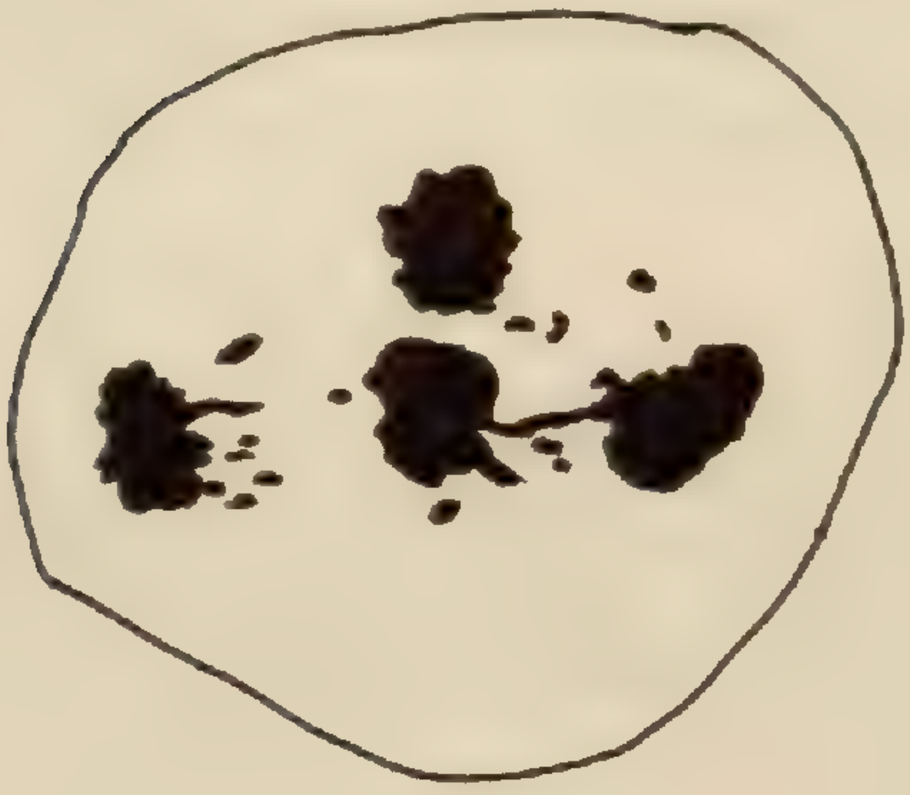

FIG. 1

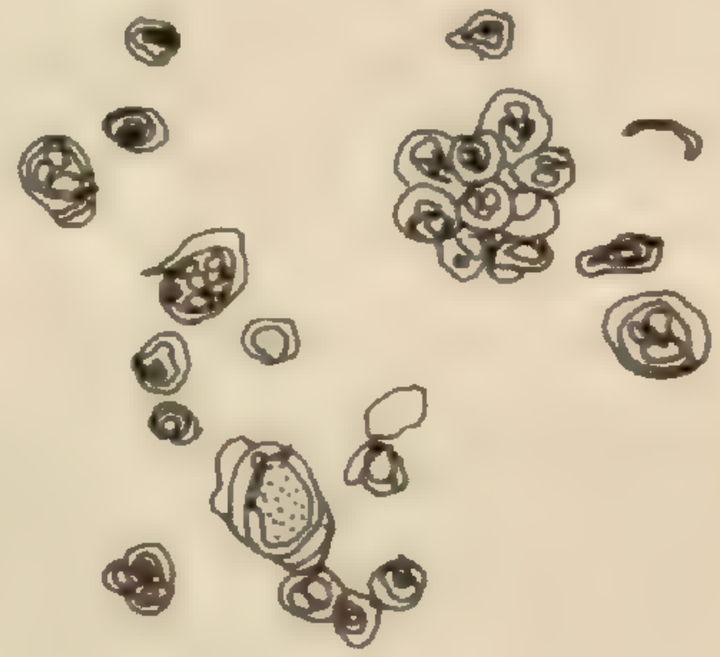

FIG. 3

FIG. 2

EQUISETUM LAEVIGATUM. FIG. 1. TELOPHASE II, SHOWING A CHROMOSOME BRIDGE AND LAGGING CHROMOSOMES, ×215; FIG. 2. ANAPHASE I, SHOWING LAGGING CHROMOSOMES, ×485; FIG. 3. SPORES, SHOWING DIVERSITY IN SIZE AND LACK OF ELATER DEVELOPMENT, ×50

for this idea. On May 31, 1957, I collected young strobili of *E. laevigatum* from a colony growing on Pine Point, Douglas Lake, Cheboygan County, Michigan (*R. L. Hauke* 111), fixed them in Newcomer's solution, squashed

them in acetocarmine, and studied meiosis. The results were very interesting: The divisions were quite irregular, with lagging chromosomes and formation of bridges (*figs. 1* and *2*). Cytologically, therefore, it would appear that *E. laevigatum* is a sterile hybrid.

This startling observation is reinforced by the intermediate character of *E. laevigatum*, between *E. hyemale* and *E. kansanum*, as can be seen from the following table.

hyemale	laevigatum	kansanum
1. Perennial.	Perennial, at least at base.	Annual.
2. Bast under ridges more extensive than bast under grooves.	Mostly resembling *hyemale* but intergrading to *kansanum*.	Bast under ridges less extensive than bast under grooves.
3. Apiculus of strobilus well-developed.	Apiculus of strobilus prominent to nearly absent.	Apiculus of strobilus mainly absent, strobilus blunt.
4. Fruiting June to October.	Fruiting late May to August.	Fruiting mid-May to July.

Equisetum laevigatum is an inhabitant of disturbed places, such as sandy lake shores, railroad embankments, and roadsides, the types of habitat where one might expect to find hybrids.

But if our familiar *E. laevigatum* is sterile, how could it become so widespread? Several factors should be considered. First, *Equisetum* is clonal and very resistant to destruction. On Pine Point, Douglas Lake, Michigan, for example, where I obtained the material for cytological study, the colony has resisted destruction by wave action and sand burial over 24 years at least, for there is a specimen in the University of Michigan herbarium collected there on June 22, 1933 (*Ehlers* 5237), the one from which I obtained the abortive spores illustrated in *fig. 3*. Secondly, *Equisetum* readily propagates itself vegetatively by fragmentation. Schaffner, 1931, showed this with *E. prealtum* (*E. hyemale*) and *E. arvense*.

Thus, a colony such as the one on Pine Point could be broken by wave action, and segments of stem carried around to other parts of the lake-shore, or down the outlet, until, landing in wet sand, they take root and produce a new rhizome system. Those species, such as *E. laevigatum*, growing in disturbed places would be most favored by such vegetative propagation.

Considering these facts, one can conceive of a sperm from *E. hyemale* fusing with an egg of *E. kansanum* to produce a single hybrid plant, which, due to heterosis, might overgrow and eliminate the normal *Equisetum* plants nearby. If this hybridization occurred on a railroad embankment (a not unlikely place for such an event) and if the railroad embankment were near a railroad center like Saint Louis, an area where both putative parents are common, then one can visualize this colony providing cuttings for dispersal in all directions and later growth into new colonies. In one hundred years a single hybridization might provide enough plants to cover a large area of the Midwest.

In the far West, the parents would most probably be *E. hyemale* and the plant known as *E. funstonii*. The latter is considered by Miss Emily L. Hartman (private communication) to be inseparable from *E. kansanum*, and she combines the two under the name *E. laevigatum* ssp. *funstonii*.

Although the presence of abortive spores and irregular meiosis in *E. laevigatum*, along with its intermediate morphology between *E. hyemale* and *E. kansanum*, argue for the hybrid origin of this species, its abundance and broad distribution will have to be accounted for. It is hoped therefore that continuing work will provide more facts bearing on the evidence for a hybrid origin of *E. laevigatum*, and the reason for its abundance and wide distribution.

DEPARTMENT OF BOTANY, UNIVERSITY OF MICHIGAN,
ANN ARBOR, MICHIGAN

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The Ball Fern in Cultivation

BARBARA JOE

The Ball Fern, *Davallia Mariesii* Moore, is currently being imported from Japan under the name *D. bullata*. Clusters of the rhizome have been fashioned into the shape of monkeys, dolls, horses, and other figures. Inasmuch as it is native to the mountains of Japan, this species should be able to withstand temperatures comparable to that of Washington, D. C. These fern figures have a tendency to dry out rather easily and must be frequently syringed to maintain sufficient moisture around the roots. Once in a while they should be given a thorough soaking. They will do best hung in a protected place away from battering winds and drying drafts. In cool climates the Ball Fern is deciduous; however, in greenhouses or warmer climates most of the fronds are persistent through the winter.

Prices range from $3.00 to $25.00 depending on the elaborateness of the figure. The monkey is about 12 inches in length and averages about $7.00 to $10.00. Supplies are most plentiful in spring when dormant shipments arrive from Japan. They are available at La Fleur Nursery, 11373 South Pico Boulevard, Los Angeles, California and Virgil Nursery, 621 North Virgil Avenue, Los Angeles 4, California.

Similar to the Ball Fern but three to four times larger is *Davallia trichomanoides* Blume, which, as the Squirrel-Foot Fern or under the mis-applied name *D. canariensis*, is frequently cultivated in Southern California. This

"Monkey" and "Horse" Arrangements of Ball Fern

fern is both attractive and very useful in garden landscaping. Although commonly used in hanging baskets, this fern is also adapted to ground cultivation. The creeping habit enables it to grow over rocks and wood, softening the surfaces with its finely cut fronds and lending a woodland atmosphere to the planting. Temperature-wise it is considered hardy to semi-hardy, having endured temperatures as low as 32°, and perhaps it may survive lower temperatures. It is evergreen.

Specimens grown in baskets have their containers thickly lined with sphagnum moss and within this nest of moss the fern is planted in a friable soil mixture (2 parts peat moss or leaf-mold to 1 part sand or sandy loam). A thin layer of moss spread over the soil aids in keeping the soil in place and protecting the rhizomes from drying out. Some growers prefer to plant baskets entirely with sphagnum moss. Once planted, adequate water and a protected place is about all this epiphyte will require. As a rule, epiphytes do well with a very small amount of mineral nutrients, and unless the plant is showing poor growth, fertilizer is best withheld. Vegetative propagation is achieved by pegging down portions of the rhizomes on sphagnum moss or partly burying them in friable soil. Rotting of the rhizomes may be indicative of over-watering or poor drainage.

Prices of *D. trichomanoides* range from $0.75 for a 2¼-inch pot size to $10.00 for baskets or those growing on driftwood. They are available at the previously mentioned nurseries and at Robert's Sub-tropical Gardens, 10136 National Boulevard, Los Angeles, California.

Davallia solida, and *D. fejeensis* and its cultivars are occasionally offered in trade. Generally they are greenhouse subjects, being tender even in Southern Californian climates.

565 NORTH WESTMORELAND, LOS ANGELES 4,
CALIFORNIA.

The Identity of Polypodium viride Gilbert

C. V. MORTON

In 1899,[1] Mr. Benjamin D. Gilbert described a new species of *Polypodium* which he called *P. viride,* which has remained a nominally valid species since that time, primarily because no one has investigated it. Recently, Mr. G. Brownlie, of Canterbury University College, Christchurch, New Zealand, has asked me about it and prompted me to look into the matter.

Mr. Gilbert wrote that his material had been collected for him by Dr. C. H. F. Peters, the astronomer-in-chief of the Transit-of-Venus Expedition of 1874. Most of Dr. Peters' collections were obtained near Queenstown, near Waikatipu Lake, New Zealand. The new species *P. viride* was described as intermediate between *Polypodium pellucidum* and *P. vulgare*, differing from both in being smaller, in having the veins only once forked, and in the fine black wavy costae, the slender green stipes and rachis, and the metallic green color of the fronds.

The Gilbert Herbarium was for some time thought to be lost, but it has been preserved. It was bequeathed to Hamilton College, which is located at Clinton, New York, and has been preserved in good condition in the herbarium of the Department of Biology of that institution. Through the courtesy of Prof. Walter N. Hess I have been privileged to borrow the type of *P. viride*, a photograph of which is reproduced in the accompanying plate.

The label of the type reads "Polypodium viride sp. n. Gilbert; Leg. Dr. C. H. F. Peters—1874; New Zealand, Middle Island." The plant is the common polypody of the eastern United States, *Polypodium vulgare* var. *virginianum* (L.) Eaton, which should perhaps be treated as a distinct species *P. virginianum* L. The cytological

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[1] Bull. Torrey Bot. Club 29: 316. 1899.

Holotype of Polypodium viride

evidence is not all in yet. It is matched perfectly by material from New York State and Pennsylvania. One must assume that somehow a plant from the eastern United States became inadvertently mixed in Gilbert's herbarium with the Peters' collections from New Zealand. Neither *P. vulgare* nor any allied species is known from New Zealand, and it seems likely that if any occurred there they would have been found by other persons than Dr. Peters.

The differences mentioned by Gilbert are not distinctive. Plants of *P. virginianum* are often quite small, the veins are mostly only once-forked, the costae *are* fine, black, and wavy, the stipes and rhachis are green, and the fronds are mostly quite persistently green. The principal distinctive character is found in the paraphyses, which are illustrated by Dr. Manton in no. 4 of the American Fern Journal for 1957. These characteristic paraphyses of *P. virginianum* are present on the plants of *P. viride*, and are conclusive proof of its identity.

UNITED STATES NATIONAL MUSEUM, WASHINGTON, D. C.

Ophioglossum vulgatum in Missouri

JULIAN A. STEYERMARK

Except for one isolated station north of the Missouri River, all other collections of *Ophioglossum vulgatum* in Missouri have been known until recently from the lowland counties of the Mississippi Embayment section of the southeastern portion of the state. The discovery during the past two years of this fern from another station north of the Missouri River and from a sector of the eastern Ozarks has necessitated a restudy of the Missouri material and has revealed the presence in the state of the two varieties, i. e., var. *pycnostichum* Fernald and var. *pseudopodum* (Blake) Farwell, as represented in the United States.

Nearly thirty years ago I found a few plants of *Ophio-*

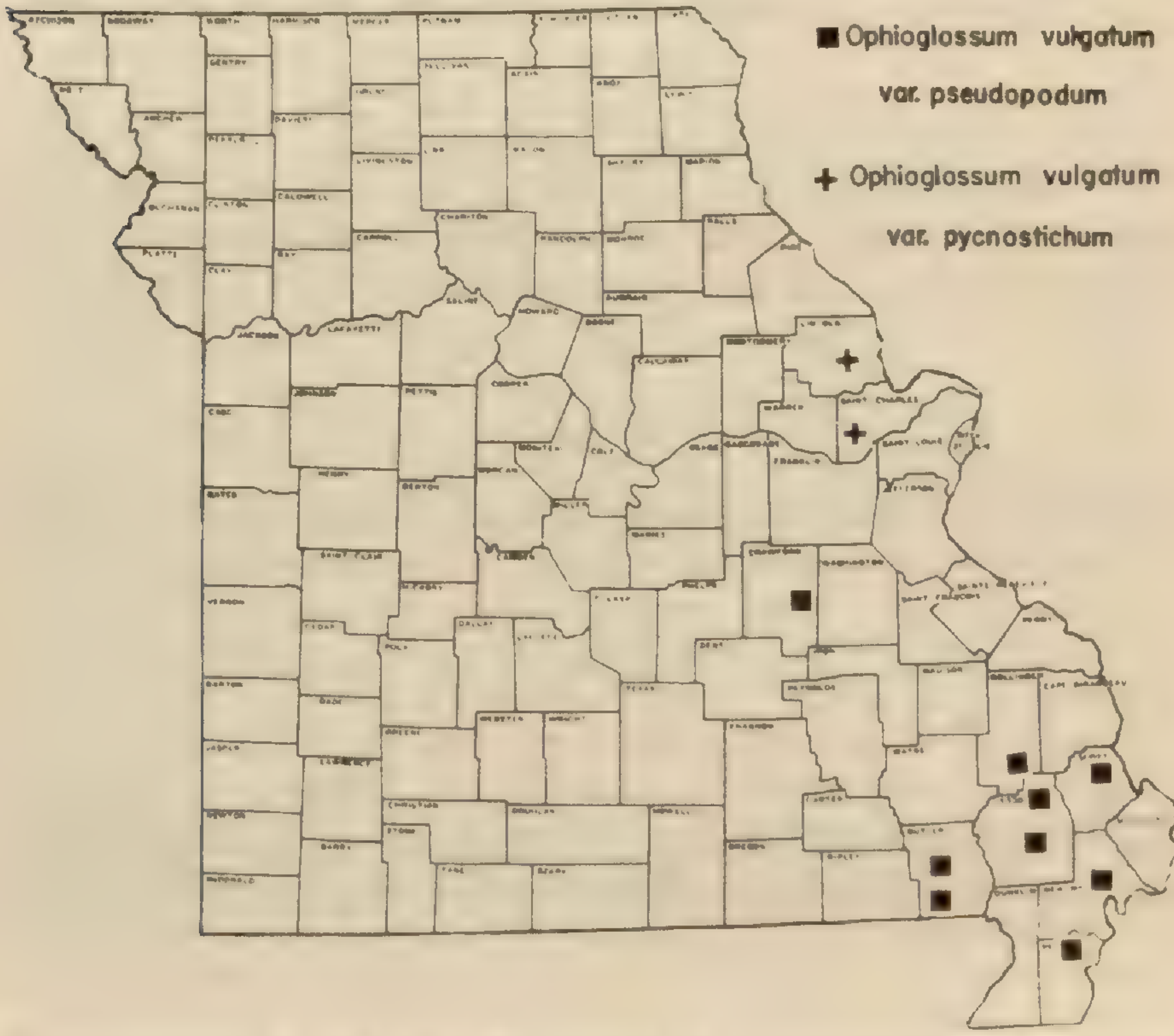
glossum vulgatum in a secluded wooded valley of Sandy Creek, west of Foley, in Lincoln County. This area, lying within a deeply dissected stratum of St. Peter sandstone of Ordovician Age, harbors a unique flora for this section of east-central Missouri. It is here that a number of species, such as *Vaccinium arboreum* Marsh. and *Mitchella repens* L., otherwise confined in Missouri to the Ozark section south of the Missouri River, reach a northern limit. Together with many other species found in this and adjacent counties, the flora partakes of an Ozark character, comprising many species known to occur only in the hilly section, entirely unglaciated, south of the Missouri River. Combined with an old weathered mantle of residual rock, this Lincoln County and surrounding area give every indication of having escaped Pleistocene glaciation.[1]

The county just south of Lincoln County, St. Charles County, is just north of the Missouri River, but, likewise, possesses a similarly predominant Ozark flora. It was, therefore, more or less expected that another station for *Ophioglossum vulgatum* would sooner or later turn up from this area. During 1956 in a rich wooded valley in St. Charles County I discovered a large number of plants belonging to this species. The data for this collection are: Locally frequent in rich wooded valley of Callaway Fork, at base of north-facing limestone wooded slopes, T 45 N, R 2 E, sect. 7 and 8, 4–5 miles southeast of New Melle, 3½–4 miles northeast of Schluersburg, St. Charles County, July 26, 1956, *Steyermark* 81994 (F, GH, MO, US). The St. Charles and Lincoln county collections both belong to *O. vulgatum* L., var. *pycnostichum* Fern.

Until 1957, these stations were separated by nearly 150 miles from the next closest known stations to the south in the state where *Ophioglossum vulgatum* occurs. Plants

[1] Cf. Steyermark, Bull. Mo. Bot. Gard. 39: 126–135. 1951; Rhodora 55: 226, 227. 1953.

from these stations, in the southeastern counties (Bollinger, Scott, Stoddard, New Madrid, Pemiscot, Dunklin, and Butler), uniformly belong to the other variety, i. e., var. *pseudopodum* (Blake) Farwell, with relatively narrower obovate or elliptic blades narrowed or tapering to the base. However, in the spring of 1957, I discovered a stand of *O. vulgatum* var. *pseudopodum* in a section of



DISTRIBUTION OF THE TWO VARIETIES OF OPHIOGLOSSUM VULGATUM IN MISSOURI

the Ozarks in Crawford County—bottom of ravine running NNE into Courtois Creek, T 37 N, R 2 W, sect 4, just north of Valley View Roadside Park, 4 miles northwest of Berryman, April 28, 1957, *Steyermark* 83927 (F). This isolated Ozark collection, the first of the species to be found within the Ozark section south of the Missouri River, now bridges the gap separating the St. Charles County occurence of var. *pycnostichum* and the

southeastern Missouri stations of var. *pseudopodum* by only 55 miles (*fig. 1*).

The specimens of *O. vulgatum* var. *pseudopodum*, cited below, have been examined in the herbaria of the Missouri Botanical Garden (MO), Chicago Natural History Museum (F), and the private herbarium of E. J. Palmer (Palmer Herb.):

BOLLINGER Co.: Low rich woods, Brownwood, April 5, 1919, *Palmer* 14716 (MO, Palmer Herb.). BUTLER Co.: Rich wooded slopes and valley woods along south side of Cane Creek, T 24 N, R 5 E, sect. 22, 6 mi. west-southwest of Poplar Bluff, April 5, 1956, *Steyermark* 80824 (F); knolls in low swampy woods, near Poplar Bluff, April 7, 1919, *Palmer* 14732 (MO, Palmer Herb.); near Neeleyville, April 8, 1919, *Palmer* 14748 (Palmer Herb.). CRAWFORD Co.: Cited previously, April 28, 1957, *Steyermark* 83927 (F). PEMISCOT Co.: Virgin woods on level ground on property of Son Rone, T 20 N, R 12 E, sect. 12, 3 mi. southwest of Portageville, July 29, 1956, *Steyermark* 82258 (F). NEW MADRID Co.: Deciduous lowland woods, T 24 N, R 14 E, NW corner sect. 32 and NE corner sect. 31, 1¾ mi. south of Henderson Mound, about four miles northeast of La Farge, April 6, 1956, *Steyermark* 80869 (F). SCOTT Co.: Rich humus in low flat ground along creek bottom, T 29 N, R 13 E, SW part sect 13, 2½ mi. southwest of Kelso, along branch of Sals Creek, July 23, 1951, *Steyermark* 72234 (F). STODDARD Co.: Rich wooded slopes below quartzite sandstone bluffs, west of Heagy, April 25, 1938, *Steyermark* 5077 (F); moist sandy soil, wooded hillsides, Dexter, April 18, 1919, *Palmer* 14765 (MO, Palmer Herb.); wooded valley along stream, Crowley Ridge, T 25 N, R 10 E, sect 1, 2½ mi. northeast of Dexter, April 7, 1956, *Steyermark* 80893 (F).

While *O. vulgatum* is relatively rare in Missouri, and always is found in rich wooded sites of valleys and low wooded ground, *O. Engelmannii* Prantl is frequent throughout southern and central Missouri, always confined to upland limestone glades and outcrops in the unglaciated section of the state. It is absent from the southeastern lowland section of the state inhabitated by *O. vulgatum*. The two diverse habitats of these species are, therefore, quite distinct in the state.

494 NORTH HILL DRIVE, BARRINGTON, ILLINOIS.

Some Critical and New Central American Species of Urostachys

W. HERTER

Next to the high-Andean regions of equatorial South America the highlands of Central America are richest in species of *Urostachys* (Lycopodiaceae), although they have been little investigated. Through the kindness of C. V. Morton, of the U. S. National Museum, Washington, D. C., I have been able to study a number of collections from this region, and I am taking this opportunity of presenting a short summary of the forms studied. The material comes mostly from the mountains of Guatemala, Costa Rica, and Panamá, but I mention a few specimens from Mexico and the Dominican Republic also. The arrangement of the species follows the order given in my system (Herter 1949–50), as did my last publication on the high-Andean *Urostachys* (Herter 1953). All the specimens cited are in the U. S. National Herbarium.

I should like to express my gratitude to Prof. Dr. W. Mevius, Director of the Staatsinstitut für Allgemeine Botanik, Hamburg, and to Dr. W. Domke, Curator of the same institution, for providing me with laboratory space in their institution and for arranging for the transportation of material.

UROSTACHYS ORIONIS Herter, Index Lycopod. 73. 1949.

COSTA RICA: Erect among small bushes in *páramo*, among *Sphagnum*, Cerro de las Vueltas, Prov. San José, alt. 2700–3000 meters, Dec. 29, 1925 Jan. 1, 1926, *Standley & Valerio* 43611, 44004, 44006. Common under shrubs on open rocky slopes above cloud-forest area, Páramo de Cerro de la Muerte, Cordillera de Talamanca, Prov. Cartago, alt. 3300 meters, Mar. 30, 1949, *L. O. Williams* 16087.

UROSTACHYS ERIKSSONII Herter ex Nessel, Rev. Sudamer. Bot. 6: 163. 1940.

GUATEMALA: Volcán Tajumulco, Dept. San Marcos, alt. 3800–4000 meters, Feb. 16, 1940, *Steyermark* 35779.

COSTA RICA: Among *Sphagnum* in *páramo*, Cerro de las Vueltas, Prov. San José, alt. 3000 meters, January, 1926, *Standley* 43613. "Orillas de una fuente en las faldas," Volcán Turrialba, 1938, *Orozco* 136.

The plants bear adventitious roots, and are ascending, and not pendent, as stated on one of the labels. Perhaps only a growth-form of *U. orionis*.

UROSTACHYS BLEPHARODES (Maxon) Herter, Index Lycopod. 53. 1949.

COSTA RICA: Near the "finca," southern slope of Volcán de Turrialba, alt. 2000–2400 meters, Feb. 22, 1924, *Standley* 35264, 35288.

UROSTACHYS **chamaeleon** Herter, *sp. nov.*

Terrestris sive subepiphyticus. Radices fasciculatae, ramosissimae, brunneae, 6–8 cm. longae. Frons erecta, postea serpentiformis, flexuosa vel subpendula, ter vel quater bipartita, rigida, sordide-vel brunneo-viridis, 2–5 dm. longa, 8–13 mm. foliis inclusis lata. Caulis basi rigidus, diam. 1–3 mm. foliis exclusis. Folia 10–12-faria, densissima, caulem tegentia, regulariter patentia vel reflexa, brunnea, linearia, coriacea, lucida, margine integro revoluta, acuminata, 5–8 mm. longa, 0.3 mm. medio lata, basi vix 0.5 mm. lata. Sporangia per totam fere plantam distributa, usque ad 1 mm. longa et 1.2 mm. lata.

Type in the U. S. National Herbarium, no. 1,307,684, collected at Barranca Grande, near San Marcos, Costa Rica, February, 1926, by Otón Jiménez.

ADDITIONAL SPECIMENS EXAMINED: Erect on wet mossy bank, Cerro de las Caricias, north of San Isidro, Prov. Heredia, alt. 2000–2400 meters, Mar. 11, 1926, *Standley & Valerio* 52083. Cerros de Zurquí, northeast of San Isidro, Prov. Heredia, alt 2000–2400 meters, Mar. 3, 1926, *Standley & Valerio* 50451. La Palma, Prov. San José, alt. 1500 meters, July 31, 1936, *Valerio* 2236.

Distinguished from the other species of the relationship of *Urostachys reflexus* by the crowded, very slender but tough, untoothed, shining leaves and the extraordinarily great variability of the forms.

UROSTACHYS REFLEXUS (Lam.) Herter, Beih. Bot. Centralbl. 39[2]: 249. 1922.

COSTA RICA: Las Nubes, Prov. San José, alt. 1500–1900 meters, March 20–22, 1924, *Standley* 38360, 38387.

UROSTACHYS PARVIFOLIUS Herter ex Nessel & Hoehne, Arch. Bot. Estad. São Paulo **2**: 395 (*seors.* 41), *t. 10, f. 2.* 1927.

COSTA RICA: Along the cart-road between Vara Blanca and La Concordia, alt. 1600–1950 meters, July 23, 1923, *Maxon & Harvey* 8454.

UROSTACHYS PRINGLEI (Underw. & Lloyd) Herter ex Nessel, Bärlappgew. 131. 1939.

MEXICO: Gueytepec, Chiapas, on trees, 1904 (?), *Münch* 81. Baduitz, Chiapas, *Münch* 94 *bis.* On exposed trees, Cuautlancillo, Veracruz, alt. 1500 meters, Mar. 1, 1938, *Copeland s.n.*

UROSTACHYS CHIRICANUS (Maxon) Herter ex Nessel, Bärlappgew. 45. 1939.

PANAMA: Epiphyte 3 feet long, vicinity of El Boquete, Volcán de Chiriquí, alt. ca. 3100 meters, July 18, 1938, *Davidson* 1021.

UROSTACHYS MANDIOCANUS (Raddi) Herter, Repert. Sp. Nov. Fedde **19**: 164. 1923.

GUATEMALA: Bank of Río Dulce, July 21, 1936, *W. R. Hatch & C. L Wilson* 59.

UROSTACHYS DICHOTOMUS (Jacq.) Herter, Beih. Bot. Centralbl. 39[2]: 249. 1922.

COSTA RICA: On tree in wet forest, Cerro de las Caricias, north of San Isidro, Prov. Heredia, alt. 2000–2400 meters, March 11, 1926, *Standley & Valerio* 52067.

UROSTACHYS SCHWENDENERI Herter, Repert. Sp. Nov. Fedde **19**: 165. 1923.

DOMINICAN REPUBLIC: On tree trunks, slope of Pan de Azúcar, Peninsula de Samaná, Prov. Samaná, alt. 400 meters, May 4, 1930, *E L. Ekman* H.14864.

UROSTACHYS **costaricensis** Herter, *sp. nov.*

Planta epiphytica. Frons pendula, subflaccida, quater vel quinquies bipartita, apice subflexuosa, pallide brunneo-luteo-viridis, 2–6 dm. longa, basi 12 mm. lata, ad apicem versus (partes fertiles) 2–3 mm. lata foliis inclusis. Partes basales (steriles) a partibus apicalibus satis diversae, sed zona intermedia in ea transeuntes. Folia densissima, 6 8-faria, caulem tegentia, erecto-patentia, basalia lineari-lanceolata, subapiculata, subplana, 12 mm. longa, 1.5 mm. lata, apicalia subcarinata, 3–5 mm. longa, 1.5 mm. lata. Caulis debilis, 0.5–1 mm. latus foliis exclusis. Sporangia 1.5 mm. longa lataque.

Type in the U. S. National Herbarium, no. 861,309, collected in Costa Rica, without special locality, March, 1908, by Robert Ridgeway (*s. n.*)

Group of *U. myrsinites.* Probably the same as the undescribed *Lycopodium costaricanum* Rosenst. (based on *Tonduz* 17614) that I mentioned in my description of *U. Killipii* (Herter 1953: 128).

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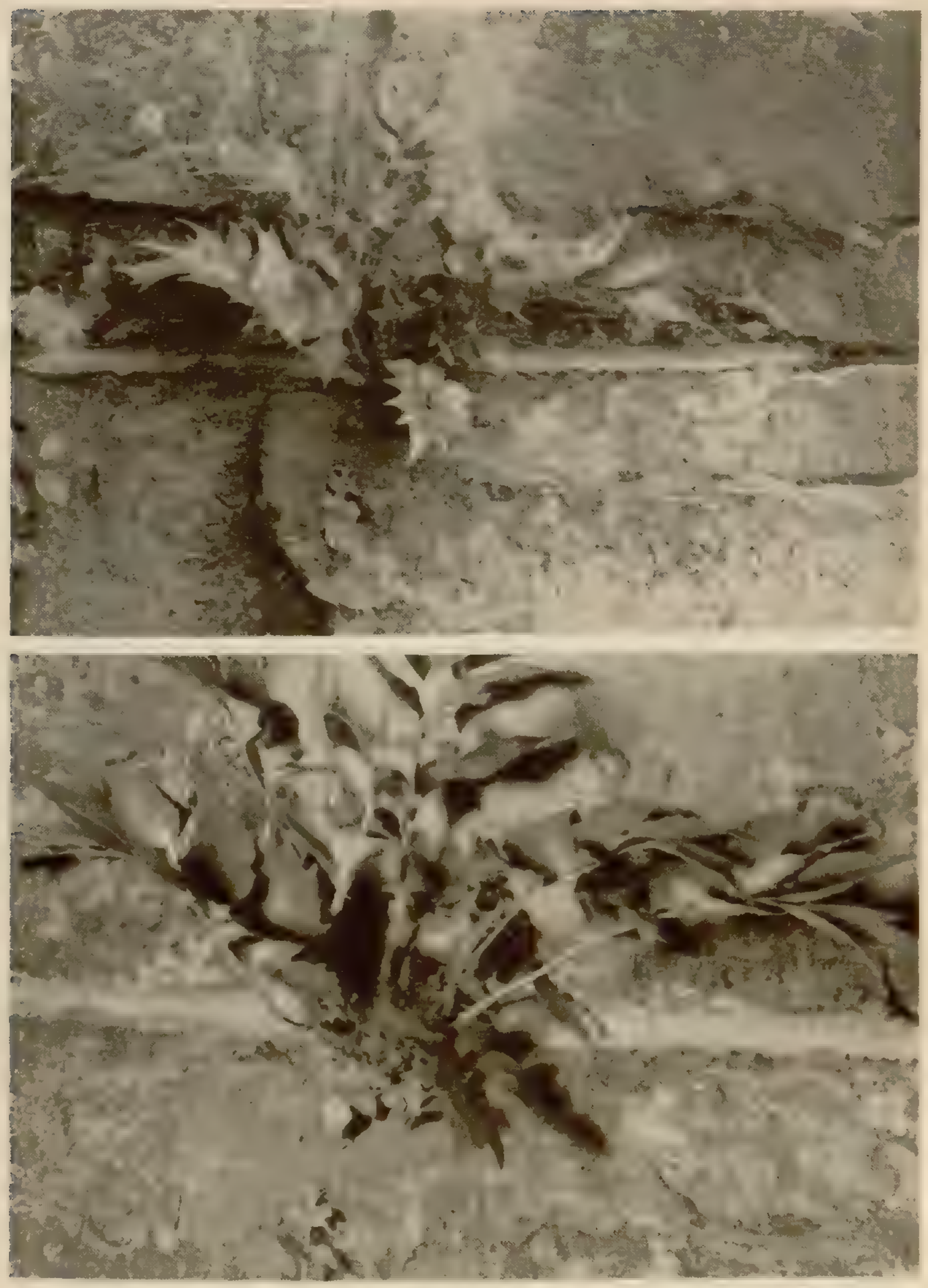
———— 1953. Neue und kritische hochandine Urostachys-Arten. Revista Sudamer. Bot. 10: 110–129.

Shorter Notes

THE HOLLY-FERN, CYRTOMIUM FALCATUM, OUTDOORS IN OHIO.—In the summer of 1956 Mr. Harold Boystel, a florist of Lancaster, Ohio, discovered a plant of the Holly-fern (*Cyrtomium falcatum,* sometimes known as *Polystichum falcatum*) growing on the outside wall of the greenhouse at the Boys' Industrial School, five miles south of Lancaster. The exact location is on the southwestern edge of section 36, Hocking Township, Fairfield County, Ohio. The fern is growing on the sandstone foundation of the greenhouse on an eastern exposure, partially protected by a planting of boxwood. The fern came up spontaneously, and survived the winter of 1956–57. It has continued to increase in size, and when examined in August, 1957, it was fruiting freely. Mr. Boystel has been unsuccessful in starting new plants from its spores. A fragment of the fern was collected and deposited in the U. S. National Herbarium.—CHARLES R. GOSLIN, *726 East King St., Lancaster, Ohio.*



Cyrtomium falcatum on Wall of Boys' Industrial School, Lancaster, Ohio

ASPLENIUM ADIANTUM-NIGRUM AGAIN.—In the last number of volume 47 of the Fern Journal, Dr. McVaugh reports *Asplenium Adiantum-nigrum* from Mexico, citing a Cyrus Pringle collection and one of his own from the state of Chihuahua. I can now add a third report, my no. 597, which was collected on the road between La Bufa and Creel, Chihuahua, on September 25, 1957. Creel is a railroad station at the end of the line in southwestern Chihuahua. Its altitude is 2340 meters (7677 feet) and its location is 107° 38′ W. and 27° 45′ N. The rocks are of igneous origin and the topography is very rugged and spectacular. Pines are the dominant arboreal species. The ferns in question, three small plants to be exact, grew in a tiny pocket in a huge block of rhyolite rock. The entire area is rich in unusual species of ferns, such as *Pellaea allosuroides* and *Notholaena Weatherbiana;* the latter has been known only from the type, which was collected at some unspecified locality in southwestern Chihuahua.—IRVING W. KNOBLOCH, *Michigan State University, E. Lansing, Michigan.*

Recent Fern Literature

A NEW FERN FLORA OF JAPAN.[1]—Floras of Japan that are usable by people that can not read Japanese are as yet practically non-existent, although illustrated floras with Japanese texts are fairly common; in fact, there are some excellent works of this kind, some with superb colored plates. The present Flora, although wholly in Japanese, contains 68 excellent habitat photographs of ferns in black and white, which make this a work of interest to western pteridologists. The text is a translation of a manuscript originally written in English by Dr. Ohwi, of the National Science Museum, Tokyo, which

[1] Flora of Japan: Pteridophyta. By Jisaburo Ohwi. pp. 1–164. *pl. 1–68.* Shibundo, Tokyo, Japan, 1957. Price 1300 yen (about $3.60).

will be incorporated in the forthcoming English edition of his Flora of Japan, which he himself has translated, and which is being edited by Dr. Fred Meyer, of the Department of Agriculture, and the first reviewer. The original Japanese edition of this Flora (1953) covered only the seed-plants, but when an English edition was considered the author prepared this additional treatment in order to cover all the vascular plants. However, the delay in issuing this English edition, and the fact that it would not meet the needs of the Japanese people, led to the issuing of this Japanese version of the pteridophyte portion.

Although Dr. Ohwi is not a special fern student, he has had many years' experience with ferns of Japan. When the professional pteridologists Professor Motozi Tagawa and Dr. H. Ito were unable to prepare the needed treatment, Dr. Ohwi undertook the task himself, attempting to steer a middle course. His treatment is designed as a practical manual and not as a technical revision. The family and generic delimitations follow Copeland's Genera Filicum closely. There are keys, accepted names, synonyms, and descriptions, but no literature citations (except in the few formal transfers in footnotes) nor citations of specimens.

Fern students of the United States would recognize many species of Japanese ferns, for there is a notable similarity between the flora of Japan and that of the eastern United States. They would, for instance, find *Matteuccia struthiopteris*, *Onoclea sensibilis*, *Woodsia ilvensis*, *W. glabella*, *Polystichum Braunii*, *P. Lonchitis*, *Dryopteris fragrans*, *D. austriaca*, *D. Filix-mas* (in the varietal form or closely related species *D. crassirhizoma*), *D. Thelypteris*, *D. disjuncta*, *D. Phegopteris*, *Asplenium Ruta-muraria*, *A. Trichomanes*, *A. viride*, *Phyllitis Scolopendrium*, *Camptosorus* (in the closely related species *C. sibiricus*), *Athyrium Filix-femina*, *A. al-*

pestre, Polypodium virginianum, Pteridium aquilinum var. *latiusculum, Cryptogramma crispa, C. Stelleri, Adiantum Capillus-veneris, A. pedatum, Botrychium Lunaria, B. lanceolatum, B. multifidum, B. virginianum, Ophioglossum vulgatum, Osmunda Claytoniana, O. regalis* (in the closely allied variety or species *japonica*), *O. cinnamomea* (in the variety, or species, *asiatica*), *Selaginella selaginoides,* and almost all the species of *Lycopodium* and *Equisetum.*

A relationship with the western United States is less apparent. The xerophytic genera *Notholaena, Cheilanthes, Pellaea,* and *Pityrogramma* are absent. Still, a relationship is shown through such species as *Blechnum nipponicum,* which is closely related to the northwestern American (and European) *B. spicant, Woodwardia japonica,* allied to the western American *W. fimbriata* and the European *W. radicans,* and "*Lastrea quelpaertensis,*" which is usually considered only a variety or forma of the western American and European *Dryopteris oreopteris.*

Nevertheless, Japan is much richer in ferns than is the United States. There are representatives of many characteristically tropical genera as *Elaphoglossum, Angiopteris, Bolbitis, Cyathea, Pyrrosia, Davallia, Lindsaea,* and many others. It may be pointed out that the genus called *Phanerophlebia* in this Flora, following Copeland, should be known correctly as *Cyrtomium,*[2] and that the name *Lastrea* is not correct, being antedated by *Thelypteris.*[3]

This book is excellently printed on high grade paper, and is sturdily bound in green buckram, a tribute to the Japanese art of bookmaking. Criticisms of the botany in this Japanese version will be duly considered in editing

[2] Cf. Morton, This JOURNAL 47: 52. 1957.

[3] A proposal to conserve *Lastrea* in the sense of Copeland and to reject *Thelypteris* was rejected by the Nomenclature Committee appointed by the International Botanical Congress at Stockholm.

the coming English edition, and may be relayed to the author through the reviewers.—E. H. WALKER and C. V. MORTON, *Smithsonian Institution, Washington, D. C.*

A REVISION OF THE FERN GENUS PELLAEA, SECTION PELLAEA[1] is a wholly admirable taxonomic account—concise, accurate, and informative. Mrs. Tryon has studied her group in the traditional herbarium manner and also in the field and greenhouse. Whenever possible, chromosome counts (by Dr. Donald Britton) were made to clarify relationships. The results are definitive enough to be of permanent value. It is unfortunate that at least some comparative studies could not have been made with species belonging to other sections of *Pellaea*, but very likely that would have extended the study beyond the bounds of a doctoral thesis, which this is. In these circumstances though, when relationships within the genus are not mentioned or known, it does seem a little inapropos to be discussing possible relationships with *Cheilanthes* and other different genera.

The species treated are arranged in two (unnamed) groups, according to the color of the stipes. The group with dark (castaneous to black) stipes is further subdivided as to whether the rhizome scales are concolorous (with a solid color), which includes *P. atropurpurea*, *P. glabella*, and *P. Breweri*, or bicolorous (with a dark central stripe), i.e. *P. ternifolia* (including var. *Wrightiana*), *P. longimucronata*, *P. mucronata*, and *P. brachyptera* (mostly from the United States). The other group, with stipes and rhachises straw-colored to ruddy brown, is subdivided into a subgroup with a stout rhizome (and concolorous scales) (*P. sagittata*, and its var. *cordata*, *P. notabilis*, and *P. Pringlei*, mostly Mexican), and a subgroup with a creeping, cord-like rhizome, further divided into species having bicolorous scales (*P. ovata*,

[1] By Alice F. Tryon. Ann. Mo. Bot. Gard. **44**: 125–193. 1957.

P. intermedia, and *P. andromedifolia*, mostly United States) and concolorous scales (*P. myrtillifolia*, Chile, and *P. rufa*, South Africa).

Perhaps the principal interest attaches to the studies of *P. atropurpurea* and *P. glabella*. I, and some other botanists, have considered the latter as only a variety of the former. Mrs. Tryon considers them as distinct species. Although she has not adduced any new distinguishing characters, her careful work should be accorded due consideration. It still is somewhat a matter of opinion, for the cytological evidence is not conclusive. It appears that *atropurpurea* is a sterile triploid ($n = 87$), and Mrs. Tryon suggests that it originated as a hybrid between *P. ternifolia* and some other unknown species; the species can be propagated from spores, but the prothallia produced on germination are not truly "gametophytic," for they have the somatic number of chromosomes, and the new "sporophytes" are produced from the prothallia adventitiously and are not the result of the fertilization of sex-cells; this type of reproduction is known as apogamy, and occurs in hybrids and other plants having an unbalanced chromosome complement.[2] The typical eastern *P. glabella* is also a sterile, apogamous hybrid (a tetraploid, $n = 116$), and Mrs. Tryon considers that it perhaps arose as a hybrid between *P. atropurpurea* (already a hybrid) and the western *P. pumila* (which is a diploid, $n = 29$). In dealing with complex issues like these, involving sterile triploids and tetraploids, taxonomic practice has not yet been standardized. Mrs. Tryon's treatment is a little inconsistent. If the hybrid *P. atropurpurea* is regarded as a distinct species, then *P. glabella* should be also, but Mrs. Tryon makes *P.*

[2] One of Mrs. Tryon's interesting observations is that apogamous strains have large, bilateral (monolete) spores, 32 to a sporangium, and that the sexually fertile species have smaller, sphaero-tetrahedral (trilete) spores, 64 to a sporangium, a difference due, of course, to the latter having undergone a second, reduction division.

glabella and *P. pumila* conspecific, the latter as *P. glabella* var. *occidentalis*. But if *glabella* is really an interspecific hybrid it is hardly possible to class it as a variety of one of its parents and not the other. The matter is further complicated by the existence of a fourth entity, *P. Suksdorfiana*, which I called *P. atropurpurea* var. *simplex*, and which Mrs. Tryon calls *P. glabella* var. *simplex*, which is also a sterile, apogamous tetraploid ($n = 116$) but a different one from typical *glabella*. The existence of these complicating western variations is the reason I referred all of them to the single species *P. atropurpurea*, even though *glabella* seems reasonably distinct when the eastern material is considered alone. The matter is highly debatable.[3]—C. V. MORTON.

Notes and News

ADVANCE PLANS FOR A 1959 FIELD-TRIP.—A number of field-trips are being planned in connection with the Ninth International Botanical Congress to be held in Montreal, August 19–29, 1959. The details of these trips have to be worked out well in advance. A tentative arrangement has been reached with Dr. Harold A. Senn, Chairman of the Field-trips Committee, for the American Fern Society to join with Trip 19, which is a three-day trip immediately after the Congress, August 30, 31, and September 1. This trip will consist of visits to laboratories and herbaria in Ottawa, certain social events

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[3] A minor misapprehension that might be noted is the statement "W. J. Hooker also considered vegetative characters as diagnostic for he arranged these species in *Pellaea* according to the division of the blade." Hooker, in his Species Filicum, habitually arranged his species according to the division of the blade in all the genera, from simple blades to the decompound ones. It was a purely artificial arrangement for convenience and no conclusion can be drawn from it as to Hooker's opinion on the relative value of diagnostic characters in the genus *Pellaea*.

scheduled for the visit of botanists to the Canadian capital, and a day's botanizing slanted toward ferns in the general region of Ottawa, both on the Quebec and Ontario sides of the Ottawa River. The leader of this trip will be Mr. W. J. Cody, the author of the recent book "Ferns of the Ottawa District."[1] The area is rich in interesting ferns. The total cost of the trip will be very moderate, probably about $25.00.

Fern Society members that either definitely or tentatively would like to take this trip are urged to write to Dr. Senn (Botany Laboratory, Science Service Building, Ottawa, Canada) and make a preliminary registration, and ask to have their names placed on the mailing list for the Congress.—C. V. MORTON.

ORGANIZATION OF THE LOS ANGELES FERN SOCIETY.—The newly formed Los Angeles Fern Society was organized March 7, 1958, with 23 members present at the organizing meeting. Another 18 charter members are expected to join. A set of By-laws, written up by Mrs. Muriel L. Merrell, was adopted, one of the provisions of which is that all elected officers must be members in good standing of the American Fern Society. Dr. W. C. Drummond was elected President, Mrs. Sylvia Leatherman, Vice-President, and Mr. George Getze, Jr., Treasurer-Secretary.

The purpose of the Society is to further interest in ferns in the Los Angeles area both from a horticultural and scientific viewpoint. To this end, a lending library is being set up and a spore exchange. Plans have been made for meetings every six weeks and for a series of field-trips. Mrs. Barbara Joe Hoshizaki has been appointed Program Chairman. Mr. Van Groot is in charge of membership.

We wish the new organization well. Active local groups can do much to promote interest in ferns, includ-

[1] Reviewed, This JOURNAL 47: 111. 1957.

ing the conservation of wild plants and the introduction of new ones into cultivation.—C. V. MORTON.

MEMBER HONORED.—Our member, Dr. W. C. Drummond, was honored at a luncheon March 13 in Hollyhock House, Barnsdall Park, Los Angeles, for his work in preparing and classifying 140 specimens of ferns for exhibition in the Nature Museum in Griffith Park. The exhibit was opened to the public on March 14.

NEW MEMBERSHIP LIST.—A new membership list (by the multilith process) of the American Fern Society was issued in April. It shows a total of 696 members as of March 1, 1958, but since that time a number have joined and the total membership as of April 28 was 721. If any members have failed to receive a list they may request one from the undersigned.—C. V. MORTON.

SPORE EXCHANGE INVITED.—Mr. Charles J. Felix (Sun Oil Production Research Laboratory, 503 North Central Expressway, Richardson, Texas) has samples of spores of a hundred or more species of ferns, many of them tropical or Old World, that he is willing to exchange for named specimens of spores. These spores have all been killed by chemical treatment and are for scientific study only and not for growing.

EXCHANGE INVITED.—Mr. Tomitaro Namegata, 481 Narita, Narita-shi, Chiba-ken, Japan, is desirous of exchanging specimens of Japanese ferns for American ones. Members interested may contact him directly.—C.V.M.

A BRITISH DEALER IN FERN SPORES.—Major V. F. Howell, Fire Thorn, Oxshott Way, Cobham, Surrey, England, has sent us an unusual catalog offering seeds of a number of rare orchids and Gesneriaceae and spores of a selection of rare ferns, including such unusual items as *Hemionitis arifolia*, *Doryopteris* [*Pteris*] *palmata*,

Adiantum macrophyllum, Diplazium proliferum, D. polypodioides, and *Todea barbara.* Members may be interested in writing for his catalogue. Major Howell writes me that for the nominal sum of $1.00 to cover expenses he will send a selection of spore-bearing fronds of native ferns from North Devonshire to any members wanting to try growing British ferns.—C. V. MORTON.

Mr. Thomas S. Constantine, 72 Terrace, Katonah, New York, has a complete set of the American Fern Journal for sale. Members interested can write him regarding the price.

American Fern Society

REPORT OF THE SPORE EXCHANGE.—The Spore Exchange in 1957 had times of activity and times of quiet. Eighty-nine letters were received from 43 members of the Fern Society and well over a hundred went out, as well as 60 lists of available spores. This amount of correspondence bespeaks a considerable interest in the exchange, although it seems that only about half of the people requesting the list followed up with requests for spores. During the year 201 packets of spores were sent to 26 people.

The disappointing part of this report is that only 13 members contributed spores or fertile leaves to the exchange, altogether 40 packets having been received, a decrease partly to be attributed to the loss of Harold Rugg, who ever had the exchange in mind and contributed many packets each year. I myself renew the supplies of the commoner eastern species each year, and so almost all the spores listed last year are still available and probably still capable of germinating. In some cases the supply is very limited or exhausted.

The need therefore, if the exchange is to continue to grow and serve the members, is for more members in various parts of the country to watch their ferns at

home and in the nearby native habitats to gather spores at the right time and to send them.

It should be emphasized again that growing ferns from spores is a rewarding experience. Little trouble or expense is involved, little experience required, and the resulting fern specimens perhaps give more satisfaction and pride than would specimens purchased or transplanted.—KATHRYN E. BOYDSTON, *Fernwood, Route 3, Niles, Michigan.*

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[1] Only changes subsequent to the new membership list are noted.

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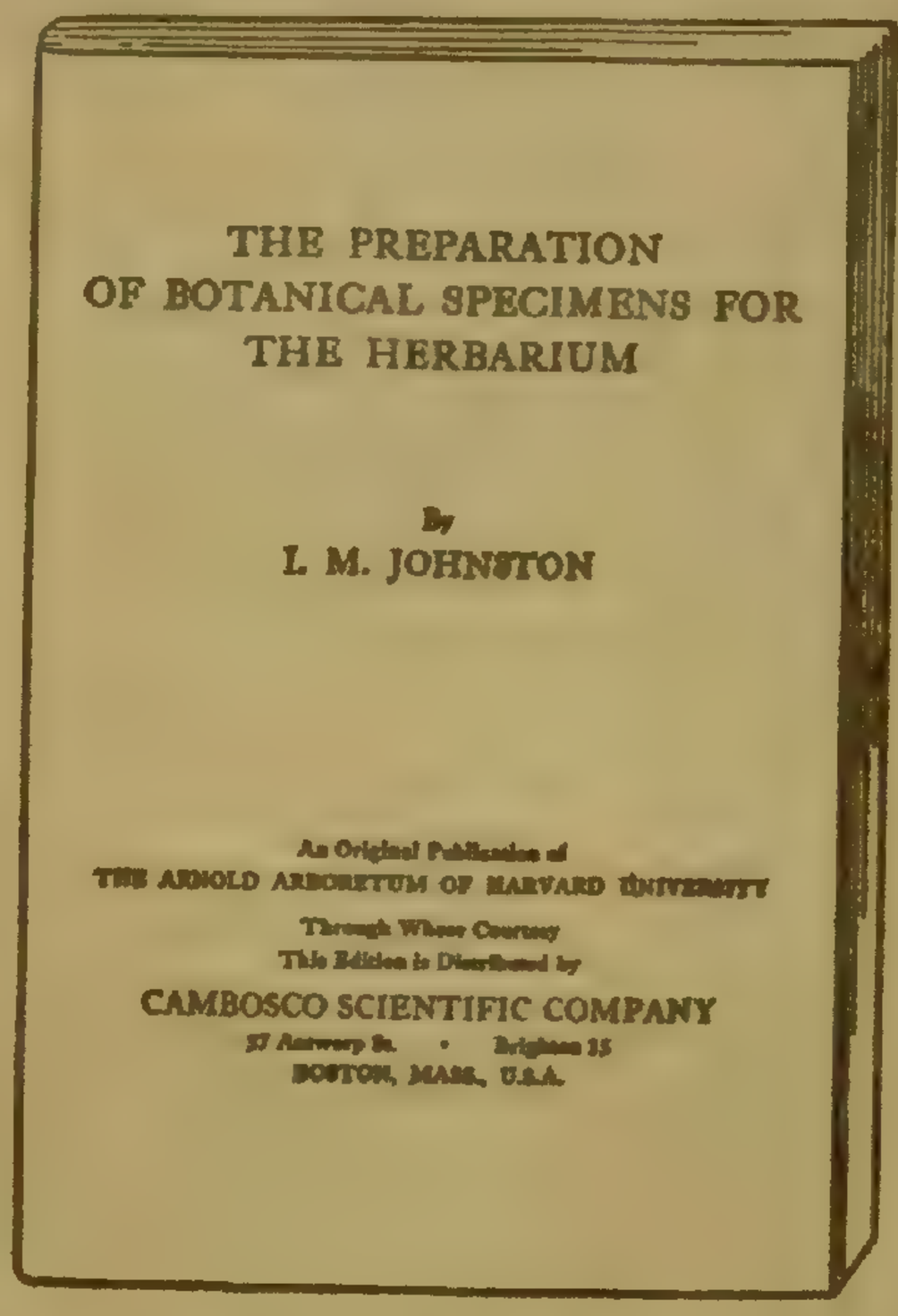

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American Fern Journal

VOL. 48 JULY-SEPTEMBER No. 2

Isoëtes in Eastern Canada

JAMES H. SOPER[1] AND SATHYANARAYANA RAO[2]

Isoëtes with its patently distinctive generic limits has remained a subject of recurring confusion concerning specific delimitation. Baker (1), one of the earliest monographers of *Isoëtes*, treated 49 species for the world. Pfeiffer (4), a later monographer, included 64 species, and her work still stands as the authoritative reference. The earlier accounts dealing primarily with the American species, those of Underwood (5) and Clute (2), contain a considerable amount of valuable first-hand field observation on *Isoëtes* worthy of more attention.

The earlier specific delimitations in *Isoëtes* were based mostly on the aquatic environment. Pfeiffer tried to base her keys on as "evident characters" as possible but admits of errors of judgment and mentions the difficulty of using certain microscopic characters which are often obscure in the dried specimens. The key characters she used were: The wall architecture of the megaspore; the number of lobes of the corm; the number and length of the leaves; the presence or absence of a velum; the peripheral strands; and the stomata. She confessed that a feature like spore sculpture evades accurate verbal description and that therefore she had to have recourse to photographs. Unfortunately, her photographs are not of much help in critical instances.

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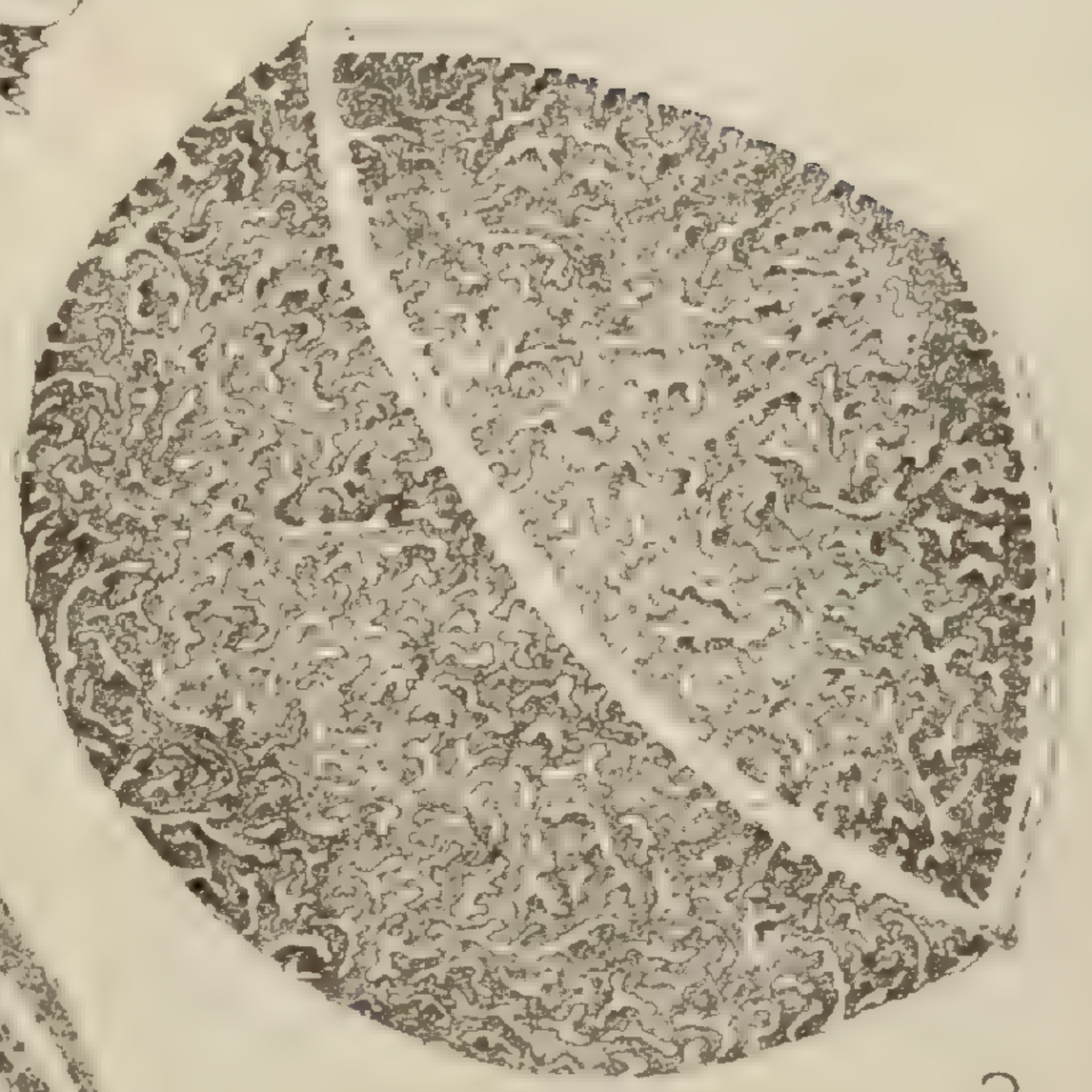

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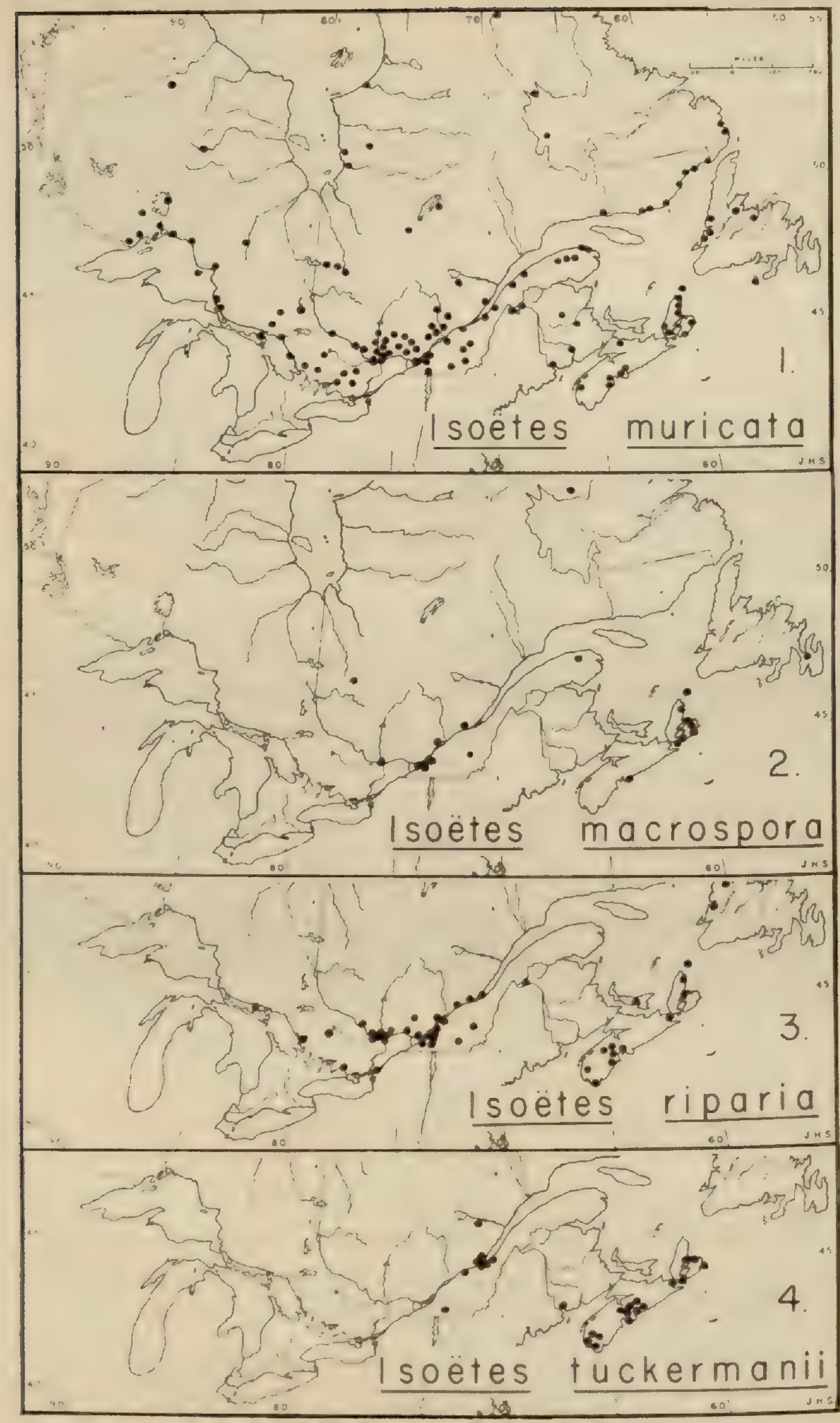
Megaspores (greatly enlarged): Fig. 1. *Isoëtes muricata;* Fig. 2. *I. macrospora;* Fig. 3. *I. riparia;* Fig. 4. *I. tuckermanii*

Although general treatments for *Isoëtes* for North America are included in several textbooks and manuals, no study has been published for this genus in Canada. The present study was made while the authors were engaged in the preparation of a manual of the Wild Plants of Eastern Canada. The problem was to provide a workable key to the species of *Isoëtes* in that area for the layman or beginning botanist. In the eighth edition of Gray's Manual, Fernald (3) has given a key for the 11 species for northeastern North America including four in our area. He followed Pfeiffer's monograph.

In the course of the present study, 312 specimens were examined from the following herbaria: University of Toronto (TRT), National Herbarium of Canada, Ottawa (CAN), Department of Agriculture, Science Service, Ottawa (DAO), and the Herbier Marie-Victorin, Institut Botanique de l'Université de Montréal, Montréal (MT). In addition, some specimens preserved in formalin-acetic-alcohol (FAA) were carefully studied. All the characters used in previous accounts have been critically examined. A considerable inconsistency or lack of correlation in reference to such characters as presence or absence of peripheral strands and stomata, extent of the velum, the number and length of the leaves, was found. A further inconsistency was in the size and sculpture of the megaspore wall, sometimes even in spores from the same plant. The original intention of providing a workable key for the layman or beginning botanist could not be achieved.

Our study has served to re-emphasize the difficulty of specific delimitation in *Isoëtes* even in a limited area like eastern Canada. However, it has served to bring out for attention and further investigation certain points heretofore ignored. In spite of the inconsistencies mentioned, the megaspore architecture continues to be the most significant single key character. Based on this



Ranges of Isoëtes in Eastern Canada

alone, the following four species have been found to be present in eastern Canada: *I. muricata* Dur., *I. macrospora* Dur., *I. riparia* Engelm. and *I. tuckermanii* A. Br.

In view of the difficulty of faithfully reproducing spore marking by photography, drawings of typical spores for the four species are here included. The distribution maps show the occurrence of these species and include the records of most of the specimens seen.

Collectors have been confused by the more or less uniform vegetative characteristics of *Isoëtes* as seen in the field and have at times included more than one species on a single herbarium sheet. In studying herbarium material one of the specimens among the several mounted on most sheets has been determined and the others assumed to be the same. In this study it was found that mixed collections were not uncommon. More than one species may occur in some localities. Considerable caution is necessary in future collections and mounting of specimens. In the dried specimens, soon after a sporangium is punctured for the extraction of spores, the sporangium becomes empty, leaving very little for a later investigator. The velum is difficult to study, since it is easily damaged in pressing. It is recommended that for each plant a separate megasporophyll be pressed flat and mounted along with the specimen and if possible additional sporophylls be placed in a packet on the sheet.

The following is the distribution of the four species studied (see also maps 1–4): *I. muricata*—Southern Labrador and Newfoundland to James Bay, south to southern Nova Scotia and southern Ontario; *I. macrospora*—Newfoundland to the Ottawa valley of Ontario and Quebec, south to Nova Scotia; *I. riparia*—Newfoundland to Georgian Bay, south to southern Nova Scotia and southern Ontario; *I. tuckermanii*—Cape Breton to St. John River, Quebec, south to southern Nova Scotia and southwestern Quebec. It may be noted that in Ontario

no collections have been seen of any species of *Isoëtes* from the region of Paleozoic sedimentary rocks south of the Canadian Shield.

In such areas as southern Nova Scotia and the St. Lawrence River valley near Montreal, three species are found together or near each other and in Cape Breton Island all four occur. This possibly accounts for the presence sometimes of abnormal spores (as to size and sculpture), which was noted by the authors. A deduction of hybridization can be made on the basis of these two facts. It is obvious that a detailed biological study of *Isoëtes* is badly needed.

SUMMARY

The study of *Isoëtes* in eastern Canada was undertaken in an effort to provide a simple key to our species. Key characters so far used have been found to be insufficiently definitive. Similarity of gross characters has led collectors to mix specimens in mounting. This is pointed out and a suggestion is made for improvement in mounting. Four species, distinguished by spore markings, have been found to occur in eastern Canada. These have been illustrated and their distributions mapped. Abnormalities in spore size and marking have been observed. This, added to the occurrence of more than one species in some areas, has led to the suspicion of hybridization. Attention is drawn to the necessity for careful field studies.

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Physiological Studies with Azolla under Aseptic Conditions. I. Isolation and Preliminary Growth Studies

LOUIS G. NICKELL

INTRODUCTION

The techniques of growing plant cells, tissues, and organs, as well as entire plants, under aseptic conditions have been a valuable aid in the fields of plant physiology and morphogenesis. Except for the investigations of Hurel-Py (6), little of the work along these lines has been with members of the Pteridophyta until recently. Wetmore and his group have worked with larger forms, particularly *Adiantum* (11, 12, 13).

The advantages of working with a smaller form, especially one which is aquatic in habit, are numerous. Probably the two most important are 1) the saving in space, and 2) the ability to work with either solid or liquid media.

The recent work of Allsopp with *Marsilea* sporelings (1, 2, 3) has made valuable contributions to this field, using a small aquatic fern as the research tool. Work with *Marsilea*, however, involves sterilization of the sporocarp, maintenance of suitable conditions for the opening of the sporocarp, liberation of the spores, development of the gametophyte, fertilization, and excision of the tiny embryo from the female prothallus. Although the results obtained from the development of sporelings from a given sporocarp have been uniform, still genetic variation has to be taken into account as a factor. Also, for the investigator not accustomed to working with ferns and not in a position to replenish his supply of experimental material, a fern that can be maintained as a clonal stock in a vegetative state would be preferable. If *Azolla* could be rendered aseptic, it would meet these

conditions. The present discussion is concerned with the technique of securing an aseptic culture of *Azolla caroliniana*, a medium for its maintenance, and preliminary studies on its growth under these conditions.

PREPARATION OF ASEPTIC CULTURE

The usual techniques employed successfully with orchid seeds (5), *Lemna* plants (9), *Marsilea* sporocarps (1), and *Equisetum* gametophytes (4) using alcohol, hypochlorite, or mercuric chloride with wetting agents were not found effective with *Azolla*. The use of these agents followed by successive rinsings in sterile distilled water removed contaminating fungi and the common bacterial contaminants. However, several days after such treatment both bacteria and algae, which are always associated with *Azolla* (10), started to appear. These were finally eliminated by treatment with antibiotics. This was done by first treating with potassium penicillin G at 50 ppm. The *Azolla* was transferred daily to a fresh solution of penicillin. After this treatment the material was placed in a basal nutrient medium (composition to be discussed later) without additives for one week. At this time transfer was made to the medium with 1 ppm of Terramycin[1] HCl added. After one week in this treatment, the material was transferred for another week to the basal medium without additives. This was followed by transfer to the basal medium plus 5 ppm of streptomycin sulfate. After this series of treatments, the material was free of contaminating microorganisms.

The *Azolla* thus obtained was subdivided to establish our stock clonal material for experimental purposes.

COMPOSITION OF BASAL NUTRIENT MEDIUM

The medium used in working with *Azolla* since obtaining the original non-sterile culture is the same as that

[1] The registered trade name of Charles Pfizer & Co., Inc., for the antibiotic oxytetracycline.

used for previous studies with *Lemna minor* (8, 9) and embryo culture studies (7). It is a synthetic medium and consists simply of a few salts, sucrose, three vitamins, and trace elements (Table 1). The pH of this medium is about 5.0 without adjusting. Any change in pH due to the addition of test compounds can be corrected by the addition of NaOH or HCl.

TABLE 1

COMPOSITION OF BASAL SYNTHETIC MEDIUM

KNO_3	0.002M	Thiamine	100 γ/L
$Ca(NO_3)_2$	0.003M	Pyridoxin	800 γ/L
KH_2PO_4	0.001M	Nicotinamide	800 γ/L
$MgSO_4$	0.001M	B	0.1 ppm
$CaCl_2$	0.003M	Mn	0.1 ppm
KCl	0.002M	Zn	0.3 ppm
$MgCl_2$	0.001M	Cu	0.1 ppm
Sucrose	2%	Mo	0.1 ppm
		Fe	0.5 ppm

CONDITIONS FOR CULTURE

The *Azolla* stocks have been maintained, and all experiments carried out, in an air-conditioned culture room in the light with controlled temperature at 22.5° C. Experimental transfers are made by cutting pieces of the desired size with a micro-scalpel from the stock clumps. All experiments are carried out in 125 ml Erlenmeyer flasks containing 50 ml of liquid medium which has been autoclaved for 15 minutes at 15 pounds pressure.

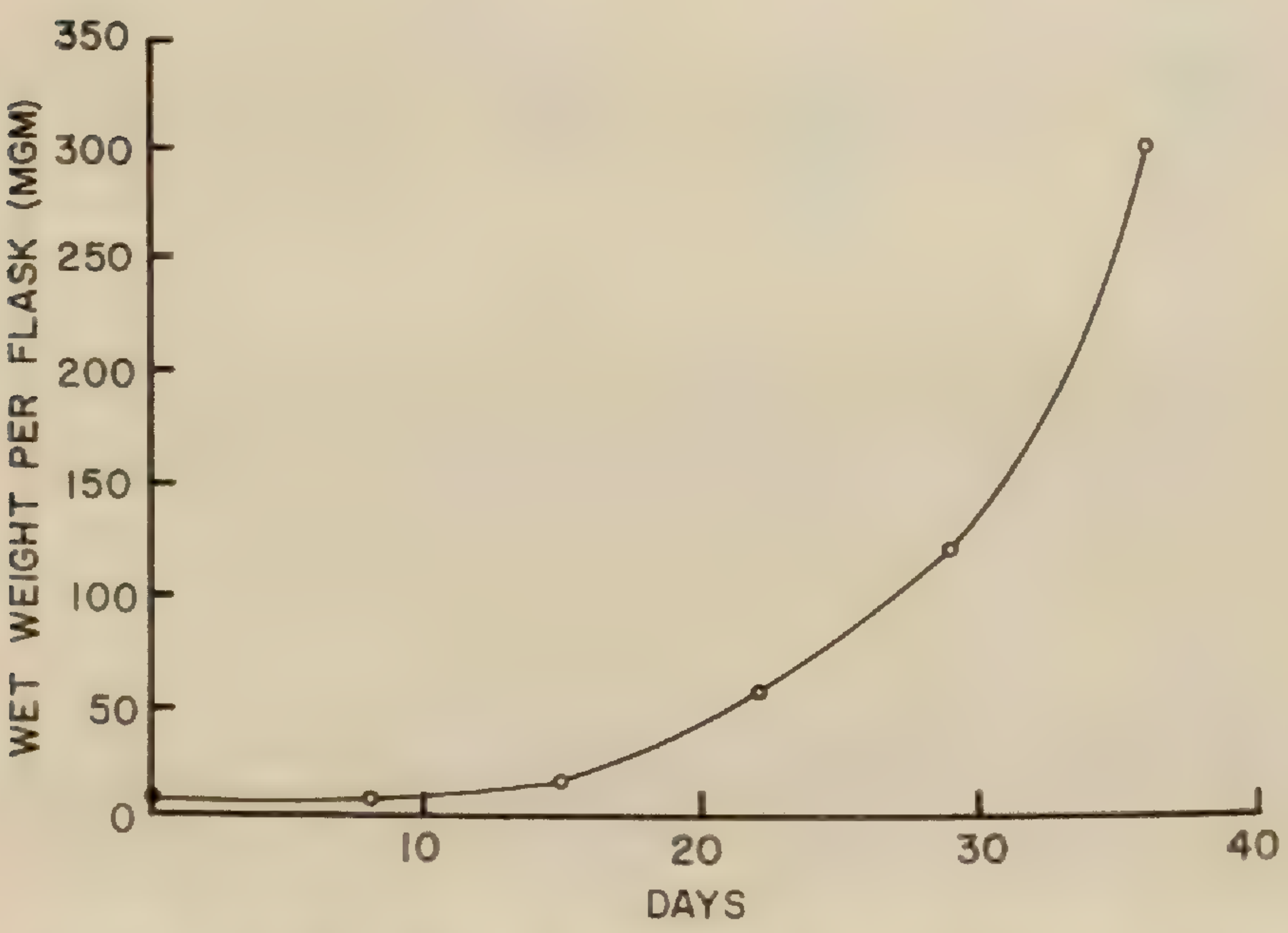
Preliminary studies showed that careful excision of experimental transplants of like size resulted in uniform growth.

The results of experiments designed to study the effects of initial pH on growth show that the *Azolla* culture will grow well throughout a wide range of pH values (from 3.5 to 7.0). In the basal medium used, values of 3.5 and 4.0 resulted in the best growth.

GROWTH RATE STUDIES

In order to ascertain the relative speed at which this

fern grows under the cultural conditions discussed above, and in order to determine when its growth enters the log phase, a growth curve was established. In order to obtain the values for the points on this curve, transfers of material weighing 5–6 mgm each were made to 50 flasks. At weekly intervals the ferns were removed from 10 of the flasks and the wet and dry weights determined. The average of the 10 weights was used. The results (*Fig. 1*) show a rather long lag phase with very little



increase in wet weight at the end of the second week. By the fourth week growth has entered the log phase.

Future experiments dealing with the nutrition of *Azolla* and with the effect of chemicals on its growth and development will be run for at least four weeks so that final weights will be representative of rapidly growing cultures.

SUMMARY

A technique for obtaining aseptic cultures of *Azolla caroliniana* has been described. A medium which will

support good growth of this fern is presented along with the method for its preparation. Successful cultural conditions for growth and the growth curve resulting from experiments utilizing these conditions show the possibilities of using this fern for physiological and morphogenetic studies. Its small size and aquatic habit are distinct advantages for laboratory manipulation.

ACKNOWLEDGEMENTS

I wish to thank R. A. Benedict for supplying the original material, which he collected in northern Georgia, Prof. R. C. Benedict for his encouragement and advice during this investigation, and C. V. Morton for his identification of the culture. This work was accomplished with the technical assistance of Miss Josephine LaBruna. Her help is gratefully acknowledged.

PHYTOCHEMISTRY LABORATORY, BIOCHEMICAL RESEARCH AND DEVELOPMENT DIVISION, CHAS. PFIZER & CO., INC., BROOKLYN 6, N.Y.

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A New Jamaican Species of Ctenitis

GEORGE R. PROCTOR

During the past several years the writer has explored some of the more remote corners of Jamaica for ferns, as a result of which a number of interesting new records have come to light. The type locality of the present new species is a precipitous mountain of white limestone called Dolphin Head, near the western end of the island in the Parish of Hanover. Here it grows among moist shaded boulders in association with other plants endemic to the area.

CTENITIS **dolphinensis** Proctor, *sp. nov.*

Ctenitis sect. Hirtae rhizomate crasso, suberecto, paleis aureo-brunneis, linearibus vel lineari-lanceolatis, attenuatis, integris dense vestito; stipitibus fasciculatis, brunneis, 30–35 cm. longis, ubique —versus basim densius— paleis bicoloribus filiformibus basi expansis vestitis;

lamina deltoideo-lanceolata, 45–70 cm. longa, basi 35–45 cm. lata, herbacea, viridi, tripinnato-pinnatifida vel subquadripinnata; rhache colore vestitu palearum stipiti simili, et brevissime glanduloso-tomentella; pinnis alternis vel subopppositis, petiolatis, deltoideo-elongatis, maximis 17–22 cm. longis, 10–14 cm. basi latis, apice attenuatis; pinnulis II ord. deltoideo-oblongis, acutis, maximis 5–8 cm. longis, basi 2.5–3 cm. latis, pinnatis, superioribus lobatis; pinnulis III ord. oblongis, sessilibus, maximis 1–1.5 cm. longis, basi 4–6 mm. latis et decurrentibus, lobatis; venis in lobis ultimis simplicibus vel 1–2-furcatis, marginem non attingentibus; costis costulisque superne et inferne brevissime albido-tomentellis; costae paleis deltoideo-attenuatis, clathratis; costulae paleis inferne bullatis et clathratis apice filiformibus; superficiebus superne subglabris inferne sparse glanduloso-puberulis; soris parvis; indusiis minimis, fimbriato-ciliatis.

Rhizome thick, suberect, densely covered with golden-brown, linear or linear-lanceolate, attenuate scales (up to about 2 cm. long), these mostly entire and glabrous but occasionally with a few minute teeth or short, several-celled marginal hairs near the apex. Stipes clustered, brown, 30–35 cm. long, densely paleate at base and becoming less so upward, the scales bicolorous (the margins and base pale ash-brown, with a central line of dark brown), filiform with an abruptly expanded broad base. Blade deltoid-lanceolate, 45–70 cm. long, 35–45 cm. broad at the base, thinly herbaceous in texture, bright green, tripinnate-pinnatifid or subquadripinnate; rachis with scales similar to those of the stipe (but smaller) and also rather densely glandular-tomentellous. Pinnae alternate or sometimes subopposite, stalked, deltoid-elongate (the lowest and largest unequally so, the lower basiscopic secondary pinnules being longer than the corresponding acroscopic ones), the largest 17–22 cm. long and 10–14 cm. broad at the base, with an attenuate apex; secondary pinnules deltoid-oblong, acute, the largest 5–8 cm. long and 2.5–3 cm. broad at the base; tertiary pinnules oblong, sessile, the largest 1–1.5 cm. long and 0.4–0.6 cm. broad at the base, deeply lobed (usually to the costule or midrib), the lowest basiscopic lobe decurrent onto the costa of the secondary pinnule. Veins of the ultimate lobes simple or 1–2-branched, the

tips not reaching the margins but ending in small pellucid spots (hydathodes ?), these bearing the sori on fertile fronds. Costae and costules on both sides densely and shortly whitish tomentellous, somewhat glandular, the costae beneath also bearing deltoid-attenuate, clathrate, somewhat bicolorous scales, and the costules beneath with bullate, clathrate scales having filiform tips. Leaf-tissue above glabrate or with a few small scattered whitish hairs, below sparsely glandular-puberulous. Sori small, with relatively few sporangia; indusia whitish, minute and soon shrivelling, with fimbriate-ciliate margins.

TYPE: Parish of Hanover, interior summit slopes of Dolphin Head, on moist wooded limestone hillside, elev. 1500–1700 feet, *Proctor* 16659, collected September 16, 1957. The type specimen is deposited at the Institute of Jamaica, Kingston; several duplicates have been distributed to other herbaria.

A chromosome count made by Dr. T. Walker[1] from the type specimen gave the typical *Ctenitis* (and dryopteroid) monoploid number $n = 41$.

This beautiful and very distinct species is the largest and most finely divided of those Antillean ferns allied to *Ctenitis hirta*. From other large members of Christensen's section *Hirtae* (as, for example, *C. grisebachii* in Jamaica), it differs strikingly in the fine, lacy cutting of its fronds, which otherwise strongly resemble *C. hirta* and *C. oophylla* in texture and color. From the latter two species it is amply distinct by its very much larger size, by the bicolorous, differently-shaped scales of the stipe and rachis, by the more intricate cutting of the fronds (a consequence of larger size), by the subglabrous upper leaf-surfaces, and by the presence of very small, whitish (instead of red), fimbriate-ciliate (instead of glandular) indusia. The chromosome count shows that this new species cannot be considered a robust, polyploid derivative of the smaller allied taxa.

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The Taxonomic Position of Saccoloma wercklei Christ

K. U. KRAMER

In 1904, H. Christ described a fern collected by C. Wercklé in Costa Rica as *Saccoloma wercklei*. It was listed under *Saccoloma* in Christensen's Index Filicum (1906), but appeared as a species of doubtful position, perhaps belonging to *Ormoloma*, in the Third Supplement (1934, p. 170). This was probably based on the authority of Maxon's comments (1933, p. 144), given in connection with his description of the latter genus. Apparently neither Christensen nor Maxon had seen the type-specimen.

When preparing a revision of the Lindsaeoid ferns of the New World (1957), I borrowed the type-specimen of *S. wercklei* from the Paris Herbarium, in which Christ's herbarium is incorporated, in order to ascertain whether that species did or did not belong in *Ormoloma*.

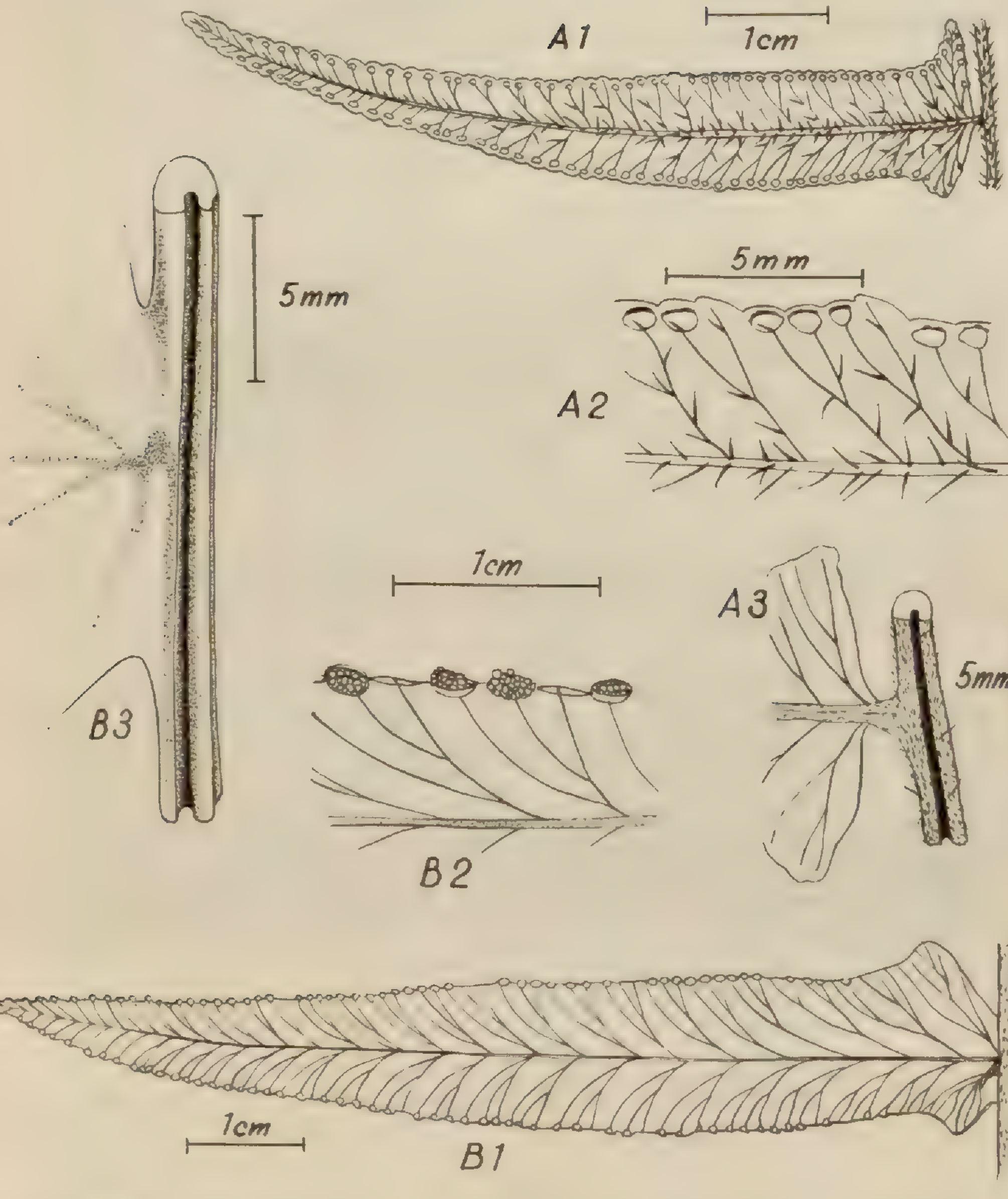
The type, as far as I know the only material extant, is rather poor (*pl. 13*). It consists of two laminas with the upper parts of the petioles; the apex of one lamina is missing, and in the other it is somewhat folded and shrivelled. No rhizome is present. Nevertheless it was immediately clear that inclusion either in *Saccoloma* or in *Ormoloma* was not justified. The only species of *Saccoloma* in its modern, restricted sense, *S. elegans*, has glabrous leaves, a rachis with two grooves on the adaxial side, separated by a more or less prominent ridge and connected with a groove on the midrib of the pinnae, and subequal, long-cuneate pinna-bases, as opposed to the hairy rachis and abaxial side of the midrib, the single adaxial rachis-groove without connection with the midribs of the pinnae (*pl. 14, fig. B3*) and subtruncate, more or less auriculate pinna-bases in *S. wercklei*. Moreover, the leaf-top consists of confluent reduced pinnae, whereas in *S. elegans* there is a distinct free terminal pinna. The latter character, the structure of the rachis, the presence

TYPE-SPECIMEN OF SACCOLOMA WERCKLEI

of rufous articulate hairs, and the sori, which project beyond the margin, exclude *S. wercklei* from *Ormoloma*.

There is, however, a resemblance to the Old-World fern *Microlepia hookeriana* (Wall.) Presl. On closer examination this resemblance proved to be more than superficial. Both species agree in their simply pinnate lamina with a few somewhat reduced basal pinnae and a rather abruptly contracted leaf-tip with confluent reduced pinnae, a single groove on the adaxial surface of the rachis with completely continuous borders, the pinnae being inserted below (that is, slightly to the abaxial side of) the edge of the groove (*pl. 13, fig. B3*), lanceolate, acute or shortly acuminate pinnae with a subtruncate base produced in a distinct auricle on the anterior and not rarely in a less pronounced auricle on the posterior side, and the presence of rufous articulate hairs. The differences may be summed up as follows:

	M. hookeriana	*"S." wercklei*
petiole and rachis	on both sides, but especially in the adaxial groove, densely clothed with large articulate up to 2 mm. long hairs	adaxially glabrous, laterally and abaxially with a very short tomentum of articulate hairs
midrib of pinnae	adaxially with similar but shorter hairs, abaxially with scattered hairs (which are also found on the lateral veins)	adaxially glabrous, abaxially with a similar indument as the rachis
pinnae	truncate at the base, with a very short petiolule (< 1 mm.), except those of the leaf-apex, which are sessile	all sessile, the posterior base ± completely adnate to decurrent, the anterior base half-free
veins	mostly once-forked	mostly 3–4 times-forked
sori	intramarginal, i.e. the indusium not equalling the margin (Pl. II, A 2)	indusium equalling the margin, fused with a marginal lobe to form a cup-shaped structure (Pl. II, B 2)



A. MICROLEPIA HOOKERIANA; B. SACCOLOMA WERCKLEI. 1, PINNA; 2, DETAIL OF PINNA; 3, JUNCTION OF PINNA WITH RACHIS

	M. hookeriana	*"S." wercklei*
sporangia	annulus with 18–21 indurated cells; head ca. 290 × 225 μ	annulus with 12–15 indurated cells; head ca. 230 × 175 μ
spores	trilete, pale yellowish, smooth, ca. 40 × 28 μ	trilete, dark brown, minutely tuberculate, ca. 30 × 25 μ

In addition, the sori of *M. hookeriana* are densely paraphysate with long articulate hairs; no such paraphyses were found in "*S.*" *wercklei*, but this might be due to the poor state of preservation, although it is not very likely. The indument of "*S.*" *wercklei* consists of short, articulate hairs, though a few one- or few-celled acicular hairs with thickened walls were also present. In *M. hookeriana*, on the other hand, the bases of the hairs have thickened cell-walls.

These differences distinguish the two species without difficulty, but they are much less pronounced than the points of resemblance mentioned above, and therefore I believe that they should be included in one genus. This brings up the question in what genus they must be placed. *Microlepia hookeriana* occupies a somewhat isolated position in the genus, and has been made the type of a distinct genus, *Scypholepia* J. Smith (1875, p. 261). This was supposed to be related to *Nephrolepis* by reason of articulate pinnae, but there is actually no articulation at all, as was pointed out by Copeland (1947, p. 51). There is only a thickening at the base of the midrib which probably serves a mechanical purpose (a similar thickening is present in "*S.*" *wercklei*, although the pinnae are adnate; it is clearly visible from the adaxial side). Recently, however, Tagawa (1951, p. 187) defended the separation of *Scypholepia* from *Microlepia* on other grounds, namely, the frequent occurrence of an auricle on the posterior side of the pinna-base, and the open angle between midrib and veins. The second character

I find to be of little relevancy, the difference being gradual rather than fundamental; but the first one seems to be of importance. I should like, however, to express it in a somewhat different way. In *M. hookeriana* (and in "*S.*" *wercklei*) the basal lateral veins are opposite, and I find it impossible to decide whether the leaf is anadromic or catadromic. The leaf-tissue extends on both sides to the same level (Pl. II, fig. B1). In all other Microlepias known to me, the leaf is distinctly anadromic, the basal vein on the anterior side being much closer to the pinna-base than the one on the posterior side, and the leaf-tissue is cut away much more strongly on this side. Possibly the presence of the swelling at the base of the midrib described above is an additional differentiating character; I have not observed it in any other *Microlepia*. It seems to me that *Scyptholepia* can be kept up as a subgenus or perhaps preferably as a section of *Microlepia*. Christensen's listing of *Scyptholepia* under *Microlepia* (1906, p. xxxviii) was probably intended as reduction to sectional rank.

The following new combination becomes necessary:

MICROLEPIA **wercklei** (Christ) Kramer, *comb. nov.*

BASIONYM: *Saccoloma Wercklei* Christ, Bull. Herb. Boiss. II. **4**: 1100. 1904.

TYPE: *Werckle* 320 from Costa Rica, without precise locality (P!).

The following corrections and additions to Christ's description, besides those already referred to above, may be given:

Petiole ca. 2 mm. in diam. Pinnae alternate or the lower ones opposite, up to 1.5 cm. wide, chartaceous. Indusium cup-shaped, consisting of the membranous abaxial (true) indusium and a more rigid marginal lobe, the two parts completely fused; receptacle very short.

Wercklé's field-notes say "(Pflanze folgt) Stiele aufrecht, *lang;* Blatt ganz *kurz*," which probably means

that the petiole is much longer than the lamina.

The inclusion of *S. wercklei* in *Microlepia* may cause surprise because of the marginal position of the sori, because *Microlepia* is distinguished from *Dennstaedtia*, its closest relative, by its intramarginal sori. *S. wercklei* is, however, so close to *Microlepia hookeriana*, as shown above, that inclusion in *Dennstaedtia* would be highly artificial. The distinction between *Dennstaedtia* and *Microlepia* should probably be redrawn on the basis of new and more numerous characters, or perhaps altogether abandoned.

A few words may be said about the phytogeographic aspect of the relationship between *M. hookeriana* and *M. wercklei*. At first sight it may be astonishing that the closest relative of a Costa Rican fern would be found in southeastern Asia (Tagawa, *loc. cit.*, gives the range of *M. hookeriana* as eastern India to southeastern China, Tongking, Formosa, Okinawa, to Borneo, Sumatra, and Java). Yet there are a few other examples of a more or less similar type of distribution. *Loxogramme*, *Coniogramme*, and *Schaffneria* each have one species in the Cordilleras of Central America and all others in southern and/or eastern Asia or in the adjacent Pacific islands. Copeland assumes that they have crossed the North Pacific. I do not know in what way this is supposed to have happened, and the solution of the problem may be more complex; but at least the phenomenon in *Microlepia* is not unique, and therefore the distribution does not provide an argument against our taxonomic conclusion. Incidentally, *M. wercklei* is the third species of *Microlepia* known from the American continent, the others being the pantropic *M. speluncae* (L.) Moore and the closely allied *M. jamaicensis* (Hook.) Fée of Jamaica and Hispaniola.

I tender my sincere thanks to Mme. Tardieu-Blot, Curator of the Fern Herbarium of Paris, for the loan

of the type of *Saccoloma wercklei*, to the Curator of the Rijksherbarium, Leiden, for loan of material of *Microlepia hookeriana*, and to Prof. R. E. Holttum for helpful advice.

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BOTANICAL MUSEUM AND HERBARIUM, UTRECHT, NETHERLANDS.

An Unusual Hawaiian Population of Ophioglossum pendulum

EUGENE HORNER

The pteridophytes of Hawaii are still not well known in detail, in spite of over a century of zealous study by amateur and professional botanists. Some 180 species exist in these islands of the central Pacific. Of these species, 19 or 20 were apparently naturalized as escapes from greenhouses, gardens, or farms since the 1880's.[1] The native plants include some of the most peculiar fern endemics in the world, such as the genus *Diellia*, a relative of the spleenworts that resembles a *Lindsaea;* the aberrant *Pteris lidgatei* which has sori like a *Cheilanthes;* and *Athyrium proliferum*, forms of which have sori

[1] Wagner, W. H. 1950. Ferns naturalized in Hawaii. Occ. Papers Bishop Museum **20**(No. 8): 95–121.

comparable to *Dennstaedtia*. In the last ten years a number of studies have been made on these plants. For example, C. V. Morton[2] investigated certain species of *Asplenium* of the Hawaiian archipelago; and R. F. Blasdell[3] worked on the two local species of *Doodia* and clarified their relationships. No sooner had Wagner reported on the genus *Diellia* than an unrecognized species of Hawaiian *Asplenium* was encountered in some old herbarium collections of 1879, a species which turned out to have great significance in interpreting the evolution and relationships of *Diellia*.[4] And no sooner had R. T. Clausen[5] completed a careful quantitative definition of *Ophioglossum pendulum* ssp. *falcatum* in the islands than the remarkable and unexpected material to be described here was found.

Professor Clausen examined many collections of *Ophioglossum pendulum* from Hawaii (where the natives used to call it "Laukahi" and used it as a cough medicine), and compared them with specimens of this wide-ranging species from other areas of the Old World tropics. He concluded that the Hawaiian plants represent no more than a subspecies (ssp. *falcatum*). The latter was found to differ from the typical *O. pendulum* (ssp. *pendulum*) in five characters—length of blade, length of fertile stalk, curvature of blades (whether falcate or not), texture (whether leathery or membranaceous), and the apices of the blades (whether blunt at apex or pointed). Using the technique of pictorialized scatter-diagrams, Prof. Clausen demonstrated two facts: (1) Plants with *falcatum* characteristics (i.e., the blade only 10–45 cm.

---

[2] Some notes on Hawaiian Asplenieae. This JOURNAL **37**(no. 4): 114–119. 1947.

[3] A comparative study of Hawaiian species of the genus Doodia. Bull. Torrey Bot. Club **83**(no. 1): 62–71. 1956.

[4] Wagner, W. H. An Asplenium prototype of the genus Diellia. Bull. Torrey Bot. Club **80**: 76–94. 1953.

[5] Ophioglossaceae of the Hawaiian Islands. Amer. Journ. Bot. **41**(no. 6): 493–500. 1955.

Two Extremes of Ophioglossum pendulum from Hawaii

long, fertile stalk only 0.5–3.0 cm. long, leaf falcate, leathery, and blunt at apex) are preponderant in Hawaii; (2) There is no decisive break between ssp. *falcatum* and the typical ssp. *pendulum*. He wrote that a specimen collected by V. O. Fosberg on Molokai "with a leaf 65 cm. long, holds the record for leaf length in the Hawaiian Islands."

In 1954, the same year Clausen's paper was published, I discovered an unusual colony of this species in the forest reserve of the "Big Island," the island of Hawaii. The fertile plants reached up to 62% larger and were more typical of *Ophioglossum pendulum* ssp. *pendulum* than any previously known from Hawaii. A representative specimen is shown in *Plate 1* by Mr. Robert F. Blasdell of the University of Michigan. In his left hand is a typical example of the common Hawaiian ssp. *falcatum*: in his right hand, a specimen from the new population.

The largest fertile leaf was 105 cm. long (nearly 3½ feet) and the fertile spikes of different specimens vary from 4 to 12 cm. long. Still larger specimens were later found, but were sterile blades only. The blades of the larger plants are straight (not falcate), of medium texture, and pointed at the tips. The larger blades were particularly interesting in forking once and sometimes two times. Surprisingly, the stalks of the fertile spikes were none over 1.5 cm. in length, although the average, according to Clausen's data, runs from 3.5 to 4.5 in ssp. *pendulum*. Only in the last respect, then, were the large plants like ssp. *falcatum*. However, some of the smaller specimens from this locality did show the falcate condition, and the shorter blades, characteristic of the ordinary Hawaiian plant.

In April, 1957, I again visited the locality where the large fertile specimens of *Ophioglossum pendulum* were gathered, and I found a few more large specimens. One of the plants in this colony was growing on a log that

had fallen and was suspended six feet above the ground, almost horizontally, between two trees. The other plants were hanging from a moss-covered tree trunk a few feet away. The exact location of the colony is in the dense forest along the road that connects the main highway to Kilauea Crater to Stainbeck Highway, about one-fourth of a mile from the juncture with the latter. The annual rainfall here is approximately 175 inches, and the elevation is between 1800 and 2000 feet above sea-level.

HAWAII NATIONAL PARK

Shorter Notes

DRYOPTERIS CLINTONIANA IN ILLINOIS.—While studying ferns in the herbarium of Southern Illinois University, the author came across a specimen of Clinton's fern, *Dryopteris Clintoniana* (D. C. Eaton) Dowell, collected in southern Illinois in 1870. This marks the first report of this species, rare in the Midwest, from Illinois, although it is known from Madison County in southeastern Missouri and LaPorte and Porter Counties in northwestern Indiana. There is little doubt that the sorus-laden fronds belong to *Dryopteris Clintoniana* even though the specimen is incomplete in that it lacks the underground portion.

The collection data read: "Damp woods near Belleville, August 7, 1870"; the determination on the sheet is "*Aspidium spinulosum* var. *Boottii* or *A. cristatum* var. *Clintonianum?*" This places the collection as from St. Clair County. The label is in the handwriting of George Hazen French, southern Illinois' first naturalist who was on the staff of Southern Illinois Normal University (now Southern Illinois University) between 1874 and 1913. It was French who discovered and for whom is named *Dodecatheon Frenchii*, the endemic shooting-star in southern Illinois.

The relocation of this station or of additional stations in Illinois for Clinton's fern would be of interest.—ROBERT H. MOHLENBROCK, *Department of Botany, Southern Illinois University.*

A NEW CALIFORNIAN STATION FOR ADIANTUM TRACYI. —On June 29, 1947, while collecting ferns on the Noyo River, Mendocino County, California, I came across a single plant of the newly described hybrid *Adiantum* × *Tracyi* growing in a large group of plants of the common *A. pedatum* on a moist clay bank about 30 feet from the water of the river. Not knowing the identity of the plant at the time, I carefully removed it and planted it in my fern box. The plant was slow in getting started again, and no new fronds appeared that year, but around the beginning of December of 1948 two fronds appeared, rather remarkably, since all the fronds of *A. pedatum* were dormant at this time. The following spring several new fronds appeared, about half the size of the original ones. After keeping this plant for four years, I decided to try to divide it, but both divisions died within six months. The fern remained unidentified until August, 1957, when C. V. Morton identified herbarium specimens. —DONALD BRANSCOMB, *Willits, California.*

Recent Fern Literature

"LOS HELECHOS DEL VALLE DE MEXICO Y ALREDEDORES," by Eizi Matuda,[1] is an account (in Spanish) of the ferns of the valley of Mexico and some adjacent regions to the west. Altogether, 30 genera and 88 species and forms are recorded. Many of the species are illustrated by photographs of herbarium specimens, and there are some fine drawings of some of the species. The nomenclature follows Copeland in general. The author is not a fern specialist, and consequently there are a large number of

[1] Anales del Instituto de Biología [Casa del Lago, Chapultepec, Mexico, D. F., Mexico] **27**: 49–168. 1956.

errors of various kinds, which it is not practicable to list.[2] Nevertheless, the work will have value to students interested in identifying material from the region treated, which is not otherwise covered in any manual currently available.—C. V. MORTON.

"THE FERNS AND 'FERN ALLIES' OF VIRGINIA,"[1] by A. B. Massey, has been reissued in a second edition, the first, issued in 1944, having been out of print now for many years. The format of the new edition is similar in every way to that of the first. The text has not been extensively revised; however, some errors have been corrected and a few names changed. The work has been abbreviated a good deal by the replacement of detailed locality citations by merely county records, by number; the number of these county references has been greatly increased as the result of recent exploration. The check-list has 110 names, but some of these are only forms or varieties; the number of species treated is 75; there are 10 hybrids listed and 25 varieties and forms. Altogether, this pamphlet is most usable.[2] It is available gratis from Professor Massey (Department of Biology, Virginia Polytechnic Institute, Blacksburg, Virginia).—C. V. MORTON.

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[2] I should mention that the species of *Dennstaedtia* that occurs in the region is listed and described as *D. mexicana* Rosenst., but this is an unpublished name. The name can not be considered validly published here, as it lacks a Latin diagnosis. This particular error is very likely due to either Dr. Maxon or myself, who may have reported identifications under this name without adding the necessary comment "*ined.*" or "*mss.*"

[1] Va. Polytech. Inst. Agr. Extension Serv., Bull. 256: pp. 1–78. *figs. 1–21.* April, 1958.

[2] Professor Massey has asked me to call attention to two errors that he has detected:

Page 27, line 1: For "Asplenium rhizophyllum (L.) Link" read "Asplenium rhizophyllum L."

Page 39, line 10 from bottom: For "VA 80, 97" read "VA 88, 97," *i.e.* Giles County rather than Clarke County as a locality for *Cheilanthes alabamensis*, which is very rare in Virginia, being known otherwise only from county 97 (Lee County).

"MANUAL OF VASCULAR PLANTS OF THE LOWER YANGTZE VALLEY, CHINA,"[1] contains a treatment of the Pteridophyta (occupying pages 23–57) by Charles DeVol. The nomenclature and generic delimitation follows Copeland closely.—C. V. M.

"CYTOLOGY OF OPHIOGLOSSUM"[2] contains chromosome counts by one of our Indian members of the Fern Society. The species treated are: *O. polyphyllum* ($n = 116$), *O. petiolatum* ($n = 510$–515), and *O. vulgatum* ($n = 480$ and $n = 410$–420). CYTOLOGY OF LYCOPODIUM,"[3] gives the following chromosome counts: *L. clavatum* (Asiatic), $n = 34$, *L. nikoscnse* (Japanese), $n = 34$, *L. setaceum* (Asiatic), $n = 165$–170, *L. lucidulum* (Asiatic), $n = 132$. The primitive basic number is considered to be 11. CYTOLOGY OF SOME INDIAN SPECIES OF GENUS ASPLENIUM L.,"[4] reports that of six species of the Western Himalayas, two (*A. Dalhousiae* and *A. varians*) are diploid ($n = 36$) and four (*A. exiguum*, *A. Trichomanes*, *A. ensiforme*, and *A. planicaule*) are tetraploids ($n = 72$). "STELAR ANATOMY OF INDIAN ASPLENIACEAE"[5] discusses 11 species of Himalayan *Asplenium*. The leaf traces are binary in all species except *A. Trichomanes* and *A. varians*, and in these the unitary traces contain two areas of xylem detached from different meristeles and are therefore merely modifications of a basic binary type. A few copies of the above-mentioned papers are available for distribution to interested students from the undersigned.—C. V. MORTON.

---

[1] By Albert N. Steward, pp. 1–621. 1958. Published by Oregon State College, Corvallis, Oregon.

[2] By S. C. Verma, Current Science **25**: 398, 399. 1956.

[3] By P. N. Mehra and S. C. Verma, Current Science **26**: 55, 56. 1957.

[4] By P. N. Mehra and S. S. Bir, Current Science **26**: 151, 152. 1957.

[5] By S. S. Bir, Abstract Proc. Indian Sci. Congress Assn. Calcutta **44**: 232. 1957.

Our only Fern Society member in Liberia, Mrs. Winifred J. Harley, has published "Handbook of Liberian Ferns,"[1] in which most of the Liberian species are illustrated by line drawings. It is essentially a popular treatment, but one that will be useful to professional botanists also, for many of these species have never been illustrated before. Unlike many semi-popular works, Mrs. Harley's names have been carefully determined, at first by Mr. Weatherby and more recently by Mr. Alston. Mrs. Harley is to be congratulated, especially in her determination to get her work published even when she had to bear the entire cost of publication herself.—C. V. MORTON.

Notes and News

Dear Mr. Morton:

It is good of you to write and offer to put a notice of my wants in the American Fern Journal. I am anxious to exchange fern spores of attractive evergreen varieties, especially the half-hardy ones that do not require greenhouse conditions and which grow outside in the warmer parts of the United States, such as California and Florida.

We have some very attractive ferns growing here to offer in return. I do not know just how cold a winter they will stand. No doubt some would prove hardier than others, especially those that grow up to 4000 feet in the mountains.

I have just returned from a trip to the highlands of New Guinea, 300 miles west of Lae. At altitudes from 7400 to 10,000 feet I collected and brought back about 300 plants, most of which appear to be establishing them-

[1] Pp. 1–114. Many figs. Ganta, Liberia. The work is undated; Mrs. Harley states that this was an oversight of the printers. The book was first distributed in December, 1957. The reviewer will take orders for the work ($2.00). Mrs. Harley points out to me that the species illustrated as *Selaginella subcordata* is not that species but the recently described *S. blepharophylla* Alston, of which Mrs. Harley's specimen is the type.

selves satisfactorily. Of course, they were not all different. It is certainly a plant-hunter's paradise. I collected some plants other than ferns, such as orchids. However, even considering the height from which they came I do not think they would stand much frost, as the climate is mild. I understand that frosts are extremely rare—in fact a calamity for the natives, who grow sweet potatoes all the year round.

Yours sincerely,
Felix M. Jury
Tikorangi
Waitara, New Zealand

April 26, 1958

Dear Mr. Morton:

In your recent article "Diplazium japonicum Naturalized in Florida"[1] you said "apparently a chromosome count [of *Athyrium thelypterioides*] has not been made." I have counted it from two localities, both in Washtenaw County, Michigan, and figured it, along with chromosomes of *Athyrium filix-femina* and *A. pycnocarpon* in my article "Cytotaxonomic observations on North American ferns."[2] There is no question that the chromosome numbers of all three of our northeastern Athyriums are $n = 40$.[3]

Sincerely yours,
Warren H. Wagner, Jr.,
University of Michigan

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[1] This JOURNAL 48: 28–30. 1958.
[2] Rhodora 57: 225, 234, 236, 237. 1955.
[3] This count of $n = 40$ confirms the usually accepted disposition of *thelypterioides* as a species of *Athyrium* rather than *Diplazium* (which has a base number of $n = 41$). C. V. Morton.

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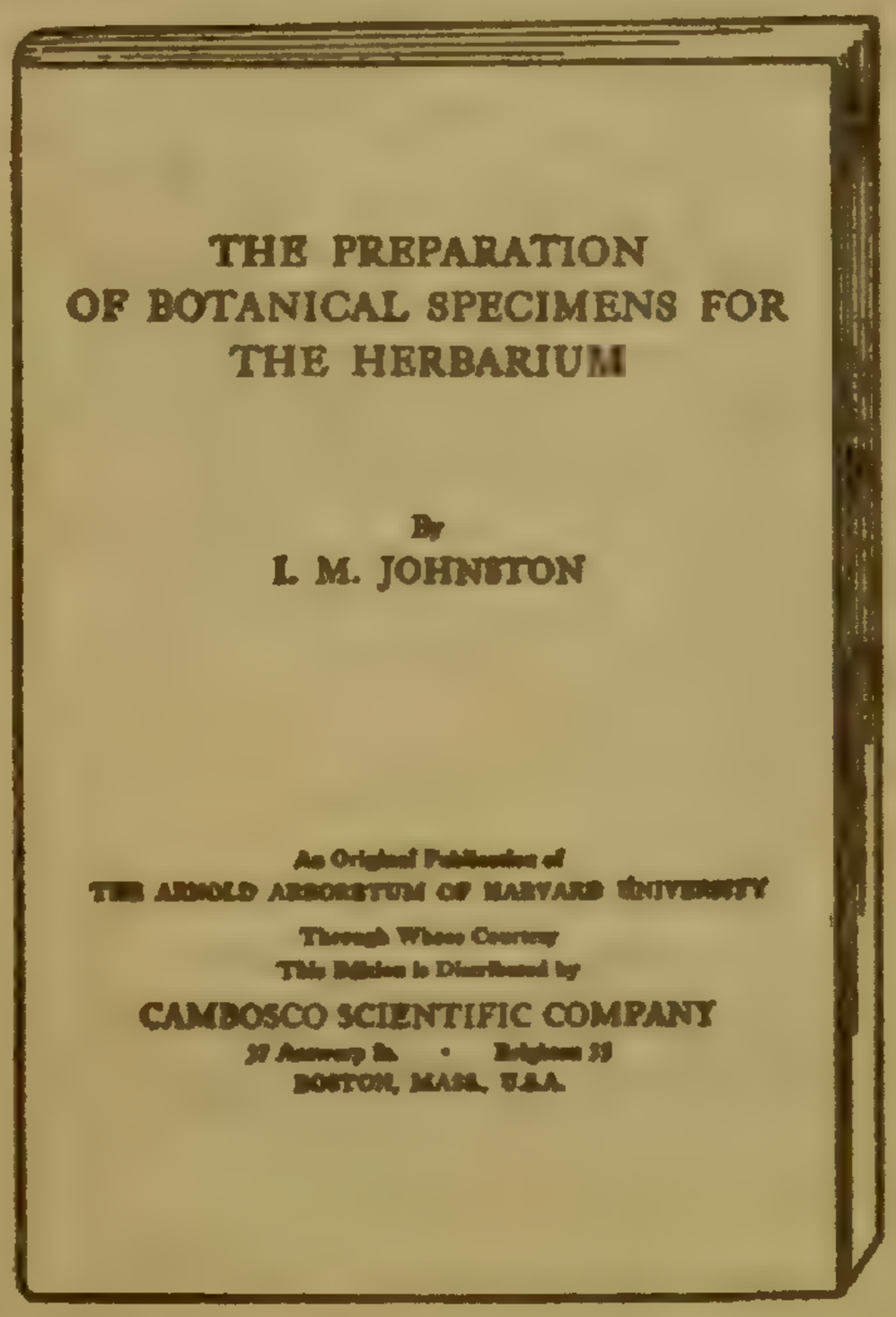

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American Fern Journal

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Una Foster Weatherby

"'What are you doing here?' I heard my husband say to a plant, and I soon discovered he was talking to a *Lespedeza* which wasn't supposed to grow in that part of the State. . . . I began to see what I could find. On glancing up the shaded roadside bank I saw five very upright fronds which suggested ebony spleenwort. . . . I could hardly wait for my husband to finish examining the plants he was interested in. This really beautiful fern proved to be the incised form of the ebony spleenwort which has only six reported stations in the United States." This sprightly report some 30 years ago in this Journal records the joys Una Foster Weatherby shared in her role of pteridologist's wife and fern enthusiast.

Long residence in and devotion to New England did not obscure a warm and vivacious nature disclosing her many Southern ties. Her father, Arthur Crawford Foster, journeyed early in his career from Foster's Settlement in Alabama to Lee County, Texas, where he taught school in winter to supplement his law work. He married one of his pupils, Margaret Ellen Edwards, and on October 11, 1878, their daughter Una Lenora Foster was born. Later she was to ponder at the singular implication of the name, for at three her mother's death left her an only child. The void was filled by a dear aunt and grandmother who provided a home in Starkville, Mississippi. There was much activity here around grandmother's grist mill and cotton gin with many cousins, orchard trees to swing and climb upon, and fine pet cats

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Mrs. Una Foster Weatherby

and chickens. She was an alert, imaginative child, interested in grandmother's reading in the Bible and classics and intrigued by the tales of Old Mose, the handyman. In this happy environment she developed a vitality which served her later in more austere moments, on strenuous field trips and long travels abroad.

At fourteen she returned to Texas to live with her father and step-mother and graduated from the High School at Haskell. She continued her active program in this frontier country—bicycling, riding, hunting, fishing, and there was instilled in her a love of freedom and a fondness for the west-Texas prairie. But such lively endeavors did not detract from scholastic achievements, for in 1896 she entered as a sophomore at Baylor University in Waco, and after two years she received a scholarship at Shorter College in Rome, Georgia. In the course of her studies there, she assisted in a bacteriology laboratory and learned the use of the microscope—an experience she found helpful in later years. She received a Bachelor of Science degree from Shorter College in the class of 1899 and returned to Haskell to serve in the office of Deputy County Clerk. Her interests, however, were in art rather than business or government. In 1902 she enrolled in the Eric Pope Art School in Boston, where for the next two years she attended classes five and a half days a week and interrupted this schedule only to teach a summer art class at Woods Hole. Her objective then became to teach art in a southern college and to further prepare herself she enrolled in the Normal Art School in Boston. With this splendid background and her many talents in art, she made her first trip abroad. In February, 1910, accompanying her father she made a three months' cruise in the Mediterranean visiting Italy, Greece, Syria, Palestine, Egypt, France, Spain, Germany, Belgium, Holland, and England. She returned to Italy the following winter in the company of an older woman from Hartford, Connecti-

cut, also interested in art. While visiting the Uffizi gallery in Florence, they chanced to meet Charles Alfred Weatherby, also of Hartford, and his mother, and this foursome toured together through the winter in Rome.

Although Mr. Weatherby returned to his work at the Gray Herbarium in Cambridge, Massachusetts, their acquaintance continued through long and frequent letters discussing art, of course, and music, politics, and poetry as well as the new ideas which were being published on philosophy and evolution by Haeckel, Sir Oliver Lodge, Mendel, and de Vries. In answer to her request to name a plant he indoctrinated a bit for her benefit. "Well, we'll call the *Potentilla* torment Una[1] for the present. That's sure to be correct as far as it goes. I perceive you have discovered one of the advantages of being a botanist. There is no place on earth, barring the poles and desert of the Sahara, where you can be altogether bored or without congenial occupation."

With his return to Hartford and later hers to Boston, their letters continued but he was also able to visit her occasionally bringing plants for her to mount and to botanize with her in the Chestnut Hill woods. When the New York publisher Frederick Stokes called upon his classmate Charles Weatherby to revise and adapt the English work, Wild Flower Preservation, by Mae Coley, for the American flora, Una Foster was commissioned to do a new illustration. Her drawing of Robin's Plantain, with various parts enlarged, in the volume issued in February, 1915, was the first of many she prepared for his publications. She painted a series of little water-colors of the Jewel Weed, *Impatiens biflora*, comparing the various color forms, and he refers to these in his papers on the species. They are preserved in the herbarium of the New England Botanical Club and although painted some forty years ago retain their bright color patterns

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[1] A pun on the plant name *Potentilla tormentilla*, a former name for the plant currently known as *P. erecta*. Ed.

and illustrate her skill in a favorite medium. More than the artist, she joined him in observing and collecting jewel weeds and a new form *platymeris*, described by Mr. Weatherby, was based on a specimen she collected on a field meeting of the Connecticut Botanical Club, August 13, 1918, at Southbury, Connecticut. The color forms of various plants were a special interest they studied together for many years.

On May 16, 1917, Una Lenora Foster became Mrs. Charles Alfred Weatherby and on their wedding trip at Lakeville, Connecticut, a little verse he wrote about her reveals their joys on a tramp through the woods. Such delightful poems and walks continued through their happy years. Mr. Weatherby's articles in Rhodora often refer to their joint ventures, and herbarium specimens document their trips over most of New England and in Nova Scotia and New Brunswick. There is an amusing account of a trip to Long Pond in the northeastern corner of Connecticut in which Mr. Weatherby brightens the botanical record with their adventures in camping overnight, in trying to collect the copious dew for drinking water while a visiting impudent mink jeeringly barked at their waterless condition. They made their home in Hartford, Connecticut, for eleven years, although Mr. Weatherby continued his work at the Gray Herbarium, spending part of each month in Cambridge. Mrs. Weatherby busied herself at home mounting the plants he brought, doing some of his typing, and preparing drawings. The large series of illustrations she prepared for his publications are particularly notable for their diagnostic value, for her object was not to include photographic detail but to stress the important characteristics of the plants. She believed these should be somewhat cartoon-like. They are especially helpful for comparative purposes in difficult or little understood groups as *Selaginella*, *Cystopteris*, *Polypodium*, *Notholaena*, and in the new species of South

American ferns he described. She illustrated also for Harold Rugg and H. C. Ridon in this Journal; three of her plates were used in the volume on the Ferns of New Hampshire by Edith Scamman, and she contributed a drawing of a new species, *Ctenopteris punctata*, for the Ferns of Liberia by Winifred J. Harley.

In 1929, with Mr. Weatherby's appointment to the Gray Herbarium staff, they moved to Cambridge and settled in their attractive home at 27 Raymond Street, a familiar address to visiting dignitaries, botanists, and students. In 1935, the Botanical Congress in Amsterdam was an invitation to visit the herbaria and botanical gardens of Europe as well as the art museums, and on August 13 they departed for Rotterdam. There was time to visit Leiden before the Congress and Mrs. Weatherby was put to work there copying some of the drawings of the Van den Bosch types. They were inspired at the Congress by distinguished botanists from all over the world and by the herbaria they visited at Utrecht, Brussels, Paris, London, Oxford, Cambridge, and Edinburgh. They resolved to return again soon to work on the ferns. In order to prepare herself, Mrs. Weatherby acquired an excellent camera and took lessons in its use, and in June, 1937, they sailed for Liverpool. They worked at length in the herbaria at Kew and Paris and made shorter trips to Vienna, Prague, and Berlin. The large series of photographs at the Gray Herbarium of fern types are mainly the result of her work on this trip. These are of such excellence that it is possible to examine their smaller detail under magnification.

The cheilanthoid ferns became Mr. Weatherby's prime interest and necessitated another trip to Europe in 1939, chiefly to London, Geneva, and Paris. A letter of August 3 notes that he was busily engaged at Paris getting out specimens for Mrs. Weatherby to photograph. Work was hardly begun when the war forced their return.

Their attention turned to photographing American

types. They visited Mount Allison University at Sackville, New Brunswick, to do the Lawson fern types. In October, 1941, they went to the Museum at Charleston, South Carolina, to photograph all of the types in the Elliott Herbarium. The Eaton fern types at Yale and collections pertinent to Mr. Weatherby's studies in the herbaria at New York and Washington were also done.

The camera served another interest of theirs—the development of art on American tombstones. They prepared an extensive illustrated manuscript on the subject, portions of which were submitted by Mrs. Weatherby for publication in journals of antiquities. Her fondness for cats brought the camera to use for a photograph of their favored cat, Moonshine, and a note about him which was published in the London Mews.

Her membership in the American Fern Society was taken in 1914 and she wrote several short reports for the Journal. In recent years she submitted two papers, one in 1952, a compilation on the English Names of North American Ferns, and another in 1955 on her observations of some ferns she had in her garden for more than 25 years. Her major contribution to botany is the volume "Charles Alfred Weatherby, A Man of Many Interests" published in 1951.[2] There is little reference to her in the book but her devotion to him and her appreciation of his work inspire it. Una Foster Weatherby died on August 19, 1957, in Cambridge and left in her will an unrestricted bequest[3] to this society, devoted to ferns, in which she and her husband participated for so many years.

ALICE F. TRYON, *Cambridge, Massachusetts*

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[2] A few copies of this are still available and may be obtained upon request from Dr. Reed C. Rollins, Director of the Gray Herbarium, 22 Divinity Avenue, Cambridge 38, Massachusetts.

[3] The Council has accepted the bequest, amounting to $3,000.00, which has been deposited in a special account assigned the name The Una F. Weatherby Fund. It or the income from it will be used as needed to further the American Fern Journal. Ed.

The Californian Species of Thelypteris

C. V. MORTON

The ferns that have been called *Dryopteris* in most treatments of ferns in California, as for example those by Maxon, in Abrams, Illustrated Flora of the Pacific States, and by Munz, in his A Manual of Southern California Botany, or, erroneously, *Aspidium*, as by Jepson, in his Manual of the California Flora, have been shown by various authors to belong to two phyletic lines that are now considered to be rather unrelated; extremists even place them in two families—the Aspidiaceae and the Thelypteridaceae. There do not seem sufficient grounds for regarding these species as belonging to different families or perhaps even subfamilies, but it is evident that two distinct groups have been wrongly united under the name *Dryopteris*. True *Dryopteris* is represented in California by the species *D. arguta*, *D. Filix-mas*, and *D. austriaca*.[1] The other species—those called by Maxon *D. Feei*, *D. oreopteris*, and *D. oregana* belong to the genus *Thelypteris*.[2]

In an article that I published some time ago in the American Fern Journal[3] I pointed out some of the distinguishing characters. I reproduce below the key that was given at that time:

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[1] Recent correspondence with Dr. Hans Peter Fuchs, who has given the matter intensive study, indicates that the name *austriaca* *may* not be properly applicable, in which case the correct name remains to be determined; very likely the well-known name *D. dilatata* will stand.

[2] It should be especially noted that this genus is wrongly called *Lastrea* by Copeland in his Genera Filicum. A proposal to conserve the name *Lastrea* in the sense of Copeland was made at the International Botanical Congress in Stockholm; it was studied by the Nomenclature Committee and voted down. The name *Thelypteris* therefore remains correct. Dr. Copeland's reasons for rejecting *Thelypteris* were based on a lack of understanding of the rules of nomenclature.

[3] 40: 217. 1950.

Acicular, unicellular hairs[4] present on the costae above; segments ciliate; stipe bundles two, these united below the base of the blade; rhizome scales ciliate (sometimes sparingly); rhizomes slender, mostly creeping; fronds membranaceous, mostly deciduous; veins reaching the margins ..... THELYPTERIS

Acicular hairs absent on the costae above (and from all parts of the blade); segments not ciliate; stipe bundles 3 to 7; rhizome scales not ciliate, sometimes toothed; rhizomes massive, short-creeping to erect; fronds mostly subcoriaceous, often evergreen; veins ending short of the margin in elongate hydathodes. ..... DRYOPTERIS

KEY TO THE SPECIES

Blades gradually narrowed toward the base, the lower pinnae much smaller than the medial ones; stipe short; veins of the segments reaching the margin above the sinus; plants of moist meadows in the high mountains of the northern Sierra Nevada. T. NEVADENSIS

Blades abruptly cut off at base, the lowest pinnae hardly shorter than the medial ones; stipes elongate; lowest veins connivent to the sinus or wholly united below the sinus; plants of southern California.

Lowest veins merely connivent to the sinus; leaf surface beneath short-pubescent ..... T. PUBERULA

Lowest veins truly united and sending an excurrent vein out to the sinus, the next distal vein also connivent to the sinus; leaf surface not pubescent ..... T. ACUMINATA

It will be noted that these specific names are not those adopted by Dr. Maxon, in Abrams' Flora (1923). The change is necessitated by a rather obscure and (even today) little-understood provision of the Rules of Nomenclature that was adopted at the Cambridge Botanical Congress in 1930 and which appeared in the 1935 edition of the Rules as Article 69; in the newest (1956) edition of the International Code of Botanical Nomenclature it appears in Article 72 as follows:

"When a new epithet is required, an author may, if he wishes, adopt an epithet previously given to the taxon in an illegitimate name, if there is no obstacle to its

[4] That is, sharply pointed, needle-like hairs.

employment in the new position or sense; the epithet in the resultant combination is treated as new.''

This sounds rather legalistic, and perhaps incomprehensible, to those not versed in the technicalities of nomenclature. It is illustrated by the following specific cases:

THELYPTERIS **puberula** (Baker) Morton, *comb. nov.*

Aspidium puberulum Fée, Mém. Foug. **10**: 40. 1865, *non* Gaud. (1827). Validly described by Fée, but an illegitimate name because a later homonym of *A. puberulum* Gaud. (1827).

Nephrodium puberulum Baker, in Hook. & Bak. Syn. Fil. ed. 2. 495. 1874. **A new epithet was required, because the prior one, *Aspidium puberulum* Fée, was illegitimate**; Art. 72 indicates that Baker was permitted to adopt the *same* epithet ***puberulum*** **when he transferred this species to** *Nephrodium*, there being no obstacle to this (in the form of a prior *N. puberulum*); Art. 72 also indicates that this name *Nephrodium puberulum* is treated as a new name, which means that the author is Baker and not (Fée) Baker, and that the effective date of its publication is 1874 and not 1865.

Dryopteris puberula (Baker) Kuntze, Rev. Gen. Plant. **2**: 813. 1891. **This is the correct name for this species under the genus *Dryopteris*.**

Dryopteris Feei C. Chr. Ind. Fil. 264. 1905. This is an illegitimate name, for it was superfluous when proposed, the legitimate name *D. puberula* (Baker) Kuntze being prior and available.

Thelypteris Feei Moxley, Bull. South. Calif. Acad. Sci. **20**: 34. 1921. An illegitimate name, since Moxley did not adopt the earliest legitimate epithet available (namely *puberula*).

These are nomenclatural considerations, quite apart from the taxonomic position of this species, the status of which is a little dubious. The Californian plant has been considered to be *T. augescens*, *patens*, or *normalis*. Until this difficult group can be studied monographically, it is best considered as a distinct species.

This species is very rare in California, occurring in a few canyons in the San Gabriel and San Jacinto Mountains and also in a few localities near Santa Barbara. It

is certainly not in general cultivation in southern California, although some plants may have been transplanted to gardens from the wild.

THELYPTERIS **nevadensis** (Baker) Clute, *comb. nov.*[5]

Aspidium nevadense D. C. Eaton, Ferns No. Amer. **1**: 73. *pl. 10.* 1878, *non* Boissier (1838). Validly published by Eaton, but an illegitimate name because of the prior *A. nevadense* Boissier, an entirely different plant.

Nephrodium nevadense Baker, Ann. Bot. 5: 320. 1891. By Art. 72, this is considered as a new name by Baker, dating from 1891, and not a new combination based on *Aspidium nevadense* D. C. Eaton. Of course, like any new name, it has the same type.

Dryopteris nevadensis Underw. Our Nat. Ferns, ed. 4. 113. 1893.

Dryopteris oregana C. Chr. Ind. Fil. 281. 1905. A new name, based on *Aspidium nevadense* D. C. Eaton. It was superfluous when published, since the name *Dryopteris nevadensis* (Baker) Underw. was prior and available, and is consequently illegitimate.

Thelypteris oregana H. St. John, Proc. Biol. Soc. Washington **41**: 192. 1928. Illegitimate, since the author did not adopt the earliest legitimate epithet available (i.e. *nevadensis*).

This species, which is closely allied and similar to the New York Fern (*Thelypteris noveboracensis*) of the eastern United States, is probably not in cultivation. Being a plant of cool, moist mountain meadows, it would not be happy in the dry and hot climate of much of California or other western states.

THELYPTERIS **acuminata** (Houtt.) Morton, *comb. nov.*

Polypodium acuminatum Houtt. Nat. Hist. **14**: 181. *pl. XCIX. f. 2* 1783.

Polypodium sophoroides Thunb. Trans. Linn. Soc. **2**: 341. 1794.

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[5] The combination *Thelypteris nevadensis* (D. C. Eaton) Clute appears as a synonym (under *Dryopteris nevadensis*) in Broun's Index to North American Ferns. It is said to have been published in Clute's Our Ferns, p. 157. 1938, but in this place the name is a *nomen nudum*, being completely without basionym. So far as I can determine, the combination has not up until now been validly published. I attribute it here to Clute, because Clute's intention was obvious even though his practice was faulty.

Dryopteris sophoroides Kuntze, Rev. Gen. Plant. **2**: 813. 1891.
Dryopteris acuminata Nakai, Bot. Mag. Tokyo **42**: 217. 1928, *non* Watts (1916).
Cyclosorus acuminatus Ching, Bull. Fan Mem. Inst. Biol., Bot. Ser. **8**: 189. 1938.

As shown by the above synonymy, the correct name under the inclusive genus *Dryopteris* is *D. sophoroides* (Thunb.) Kuntze, since the name *D. acuminata* (Houtt.) Nakai is a later homonym. Under *Thelypteris*, however, the earliest specific epithet *acuminata* may, and must, be used.

The group "*Cyclosorus*" was clearly delimited first by Christensen (in his Monograph of American Dryopteris); in the subgenus *Lastrea* the veins all reach the margin of the segments above the sinus, whereas in *Cyclosorus* the lowest pair (or the lowest several pairs) are "connivent," i.e. approach each other and run along parallel up to the sinus, or (sometimes in the New World species and generally in the Old World) the lowest pair (or sometimes the lowest several pairs) actually join each other in the leaf tissue and send out a common branch (excurrent vein) to the sinus; in the latter case, the next higher veinlet may also run to the sinus. This kind of venation is known as "goniopteroid."

Copeland tried to put those species with connivent veins (such as *patens*) in his "*Lastrea*" (i.e. *Thelypteris*) and the species with truly united veins (such as *dentata*) in *Cyclosorus*, but such a treatment is wholly artificial and unnatural, for *patens*, *normalis*, *augescens*, and the other species with connivent veins are clearly more closely allied to *dentata* and other *Cyclosorus* species than they are to typical *Lastrea* (*i.e. Thelypteris oreopteris*, *T. palustris*, *etc.*). Christensen really knew the American species of *Dryopteris* and their relationships where Copeland did not. No one, not even Copeland, has considered that the subgenus (or genus, according

to Copeland) *Goniopteris* should be split into two according as to whether the veins are truly united or merely connivent; in fact such a distinction would be impossible, for some species have the veins partly merely connivent and others truly united; such a species is *Thelypteris tetragona* (*i.e. Dryopteris subtetragona*). For these reasons, I find it impossible to recognize a genus *Cyclosorus* as delimited by Copeland; it would be possible to recognize *Cyclosorus* as delimited by Christensen, but I do not find such a treatment necessary, for it seems that *Cyclosorus* finds its natural position as a subgenus of *Thelypteris*, just as does *Goniopteris*, *Steiropteris*, *Glaphyropteris*, and some of the other natural units of this genus.

It may be surprising to find *T. acuminata* listed as a member of the Californian flora. It is not, of course, a native, being in fact an inhabitant of Japan and China. Nor is it truely naturalized. In Rosecroft Gardens (a commercial nursery, about 2 miles from the ocean in Point Loma, near San Diego), it is growing luxuriantly and has spread under the trees and bushes (*MacFadden* 27189, US). But it has not been found outside the nursery. However, it is evidently adapted to the climate of southern California and may possibly become naturalized eventually. I have mentioned this species primarily because it has been well known in cultivation for some time without the botanical name having ever been determined.

The introduction of this species into California remains obscure. It has been offered by dealers as "*Aspidium*" (i.e. *Dryopteris*) cv. 'K. O. Sessions.' Prof. Joseph Ewan informs me that "K. O. Sessions" refers to Miss Kate Olivia Sessions (born about 1880, died 1949, a horticulturist and long-time resident of San Diego, California. Very likely Miss Sessions imported these plants from the Orient long ago and they were called by

her name because the proper botanical name was unknown; however, they do not seem to be truly a cultivar, that is, a distinct form originating under cultivation, and therefore the name "K. O. Sessions" should be abandoned.

SMITHSONIAN INSTITUTION.

The Correct Name of the Mountain Fern

HANS PETER FUCHS

For the last fifty years, the specific epithet *oreopteris* has been generally accepted for the mountain fern, usually known as *Dryopteris oreopteris* (Ehrh.) Maxon or *Thelypteris oreopteris* (Ehrh.) Slosson in Rydb, although the formerly accepted epithet *montana* has still been used occasionally.[1] Without any doubt, the oldest name is *Polypodium montanum* Vogler (1781: 4), which is, however, not available, as it is a later homonym of *Polypodium montanum* Lam. (Fl. Franç. 1: 23. 1778).[2] However, there is another competing name that must be investigated seriously, namely *Polypodium limbospermum* Allioni (1789: 49). which was validly published in the same year (1789) as *Polypodium oreopteris* Ehrh.

The identity of *Polypodium oreopteris* has always been clear by reason of the exsiccati sheets distributed by Ehrhart in 1785; sheet 22 in "Dekas II" of his "*plantae cryptogamae Linnäi*" [*sic*] bears the name *Polypodium Oreopteris* Ehrhart (as a *nomen nudum*). Through the

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[1] Recently, Pichi-Sermolli (Taxon 3: 69. Feb. 1954) wrote that another epithet will probably have to be substituted for *oreopteris*, without indicating which one. Very likely he was thinking of *Polypodium pterioides* Lam. (Fl. Franç. 1: 18. 1778), which Woynar (Mitt. Natw. Ver. Steiermark 49: 156–158. 1913) and others have believed to be an older name than *oreopteris* for this species. However, I shall show in another nomenclatural note that it is not referable to the species in question.

[2] Concerning the date of publication of volume 1 of Lamarck's Flore françoise, cf. Becherer, Ber. Schweiz. Bot. Ges. 38: 24, 25. 1929.

friendly help of Prof. Dott. Uberto Tosco, it has been possible to establish the identity of *Polypodium limbospermum* Allioni definitely. He has sent the writer some photographs of the type specimens in the Allioni herbarium in Turin.[3] These consist of two sheets, with three and two fronds respectively, the latter marked by Allioni as "*Polypodium limbospermum—Aspidium oreopteris* Sw." The specimens are referable to the mountain fern.

The taxonomic identity of the species described as *Polypodium oreopteris* and *P. limbospermum* makes it necessary to investigate the priority of these names. Woynar (*loc. cit.* 156) wrote that the equally(?) old *P. limbospermum* must probably be rejected in favor of the well-known *P. oreopteris*, and Schinz and Thellung (Vierteljahresschr. Natf. Ges. Zürich **60**: 339. June 10. 1915) expressed the same opinion with greater certainty. A decision on this point can only be made by ascertaining, if possible, the exact or relative dates of publication of these two names.

The species *Polypodium oreopteris* was described for the first time in the fourth volume of Ehrhart's "Beiträge zur Naturkunde und den damit verwandten Wissenschaften." The approximate date of publication can be proved quite easily by the preface to this volume, which is dated "Herrenhausen, 1789, April, 3," and in which Ehrhart wrote: "*Hier, lieber Leser, ist endlich der vierte Band meiner Beiträge. Dass solcher einige Monathe späther erscheinet, als ich in der Vorrede zum dritten Bande angekündigt habe, kommt von dem letzten kalten Winter und dem dadurch verursachten Mangel am Papier.*" Thus, Ehrhart's work can not have been published earlier than April 3, 1789.

The date of publication of Allioni's "*Auctarium ad*

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[3] For this kind assistance, the writer wishes to express his gratitude.

floram pedemontanam'' can be nearly fixed by a letter from Villars to Allioni that has been preserved in the library of the Academy of Sciences in Turin (Cat. no. 4528–29). In this letter,[4] dated "Grenoble 1er avril 1789." Villars thanked Allioni for the reception of his book: "*Monsieur, je reçois avec un plaisir et une reconnaissance infinie votre auctarium florae pedemontanae: C'est un nouveau gage de votre amitié généreuse . . .*" There is therefore no doubt that Allioni's book must have been published earlier than April 1, 1789, and therefore it follows that *Polypodium limbospermum* Allioni clearly has priority over *P. oreopteris* Ehrh.

The mountain fern is now properly referred to the genus *Thelypteris* Schmidel,[5] under which genus the following new combination is necessary:

THELYPTERIS **limbosperma** (Allioni) H. P. Fuchs, *comb. nov.*[6]

Polypodium montanum Vogler, Dissert. Polypod. montanum 4. 1781.[7]

Polypodium fragrans sensu Huds. Fl. Angl. ed. 2. 457. 1778, *non* L. 1753.

Polypodium Thelypteris sensu Huds., loc. cit., non Weis, 1770.

Polypodium limbospermum Allioni, Auct. Fl. Pedemont. 49. **(Prior to April 1) 1789.**

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[4] This letter was published by Gras (Bull. Soc. Bot. France 7: 583. 1860), in part.

[5] On page 45 of the text, Schmidel (1762) spelled the name *Thelypteris*, but used the spelling "*Thelipteris*" on page 5 and on the plate (*t. 11, f.* 1–3). The question of orthography can be settled by the fact that Schmidel took his name from Ruppius (1718: 322), who used the spelling *Thelypteris*.

[6] This combination has been used previously by the writer (Taxon 3: 134. 1954) and by Janchen (Cat. Fl. Austriae 73. 1956), but without the citation of the basionym, which is necessary for valid publication after Jan. 1, 1953, according to the International Code of Botanical Nomenclature (1956 edition).

[7] The specific epithet *montanum* has been transferred to the following other genera by various authors (cf. C. Christensen, Index Filicum): *Polystichum, Hemestheum, Lastrea, Aspidium, Nephrodium, Phegopteris, Filix,* and *Filix-mas.*

Polypodium Oreopteris Ehrh. Beitr. Naturkde Verw. Wiss. 4: 44. (Later than April 3) 1789.[8]
Polypodium pterioides sensu Villars, Hist. Pl. Dauphiné 3: 841. 1789, *non* Lam. 1778.
Aspidium odoriferum S. F. Gray, Nat. Arr. Brit. Plant. 2: 6. 1821.
Polystichum glandulosum Dulac, Fl. Départ. Hautes-Pyr. 32. 1867, *non* Presl, 1836.
Dryopteris montana O. Kuntze, Rev. Gen. Plant 2: 813. 1891.
Dryopteris oreopteris Maxon, Proc. U. S. Nat. Mus. 23: 638. May 4, 1901.
Polypodium subpubescens J. Bergeret, Fl. Basses-Pyr. 757. 1909.
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SMITHSONIAN INSTITUTION, WASHINGTON, D. C.

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[8] The specific epithet *oreopteris* has been transferred to the following genera by different authors: *Polystichum*, *Aspidium*, *Lastrea*, *Nephrodium*, *Phegopteris*, and *Hemestheum*.

A New Hybrid Spleenwort from Artificial Cultures at Fernwood and its Relationship to a Peculiar Plant from West Virginia

W. H. WAGNER, JR. AND KATHRYN E. BOYDSTON

Since the laboratory studies of Appalachian Asplenia were begun six years ago, a number of interesting facts have been discovered. Our evidence now indicates that only three basic species—*Asplenium montanum*, "mountain spleenwort," *A. platyneuron*, "ebony spleenwort," and *A. rhizophyllum*, the "walking fern"—have generated a large series of hybrid ferns, some sterile and some fertile, now numbering, in total, nine different taxa, one of them occurring in two cytological forms. The ones known as fertile plants are *A. bradleyi* (*A. montanum* × *platyneuron*), *A. ebenoides* (*A. platyneuron* × *rhizophyllum*), and *A. pinnatifidum* (*A. montanum* × *rhizophyllum*). Those known only as sterile plants are *A. bradleyi* × *platyneuron*, *A. ebenoides* (sterile form), *A. ebenoides* × *platyneuron*, *A. trudellii* (*A. montanum* × *pinnatifidum*), *A. bradleyi* × *montanum*, *A. gravesii* (*A. bradleyi* × *pinnatifidum*), and *A. kentuckiense* (*A. pinnatifidum* × *platyneuron*). To this rather overwhelming list, we now have an additional hybrid to be described here. We also have a unique plant collected in the wild in West Virginia some years ago, the identification of which now seems to be possible.

The new hybrid is a backcross of *Asplenium ebenoides* (*A. platyneuron* × *rhizophyllum*) with one of its parental species, *A. rhizophyllum*. It is the first record of *A. rhizophyllum* being involved in a secondary hybridization. The initial hybrid, *A. ebenoides*, is probably the best known of all hybrid ferns, in part because its hybrid nature was a controversial matter for many years before the plant was produced artificially in culture, and in part because it is so well known to fern students as an odd-

looking plant which appears fairly regularly in nature wherever the parents occur together, and which grows well under indoor culture conditions. To the relevant facts concerning its hybrid nature listed in an earlier article,[1] two new items have been added. The entire list of important facts is as follows: (1) *A. ebenoides* is a morphological intermediate between *A. platyneuron* and *A. rhizophyllum;* (2) it was produced artificially through crossing the two putative parents in culture in the classic experiment of Slosson; (3) spore abortion in sterile individuals of the hybrids is shown to be due to complete non-pairing of parental chromosomes so that only univalents (unpaired chromosomes) are visible at meiosis; (4) fertile plants of *A. ebenoides* have undergone chromosome doubling, and form 72 normal chromosome pairs at meiosis; (5) a backcross of fertile *A. ebenoides* from Alabama with one of its parents, *A. platyneuron,* shows approx. 36 pairs and 36 univalents[2] at meiosis; and (6) sowing in artificial cultures numerous spores of sterile $2n$ plants from Maryland shows that a small fraction of spores are formed with the doubled number, and these produce a new $4n$ race of *A. ebenoides.*[3] These facts bear more or less directly on the plants to be discussed here.

The new hybrid *Asplenium ebenoides* × *rhizophyllum* arose spontaneously in an inadvertently contaminated culture of one of the parents. It was grown by one of us (K. E. Boydston) at Fernwood, Niles, Michigan, together with numerous plants of *Asplenium rhizophyllum,* and it was immediately distinguishable, both from the

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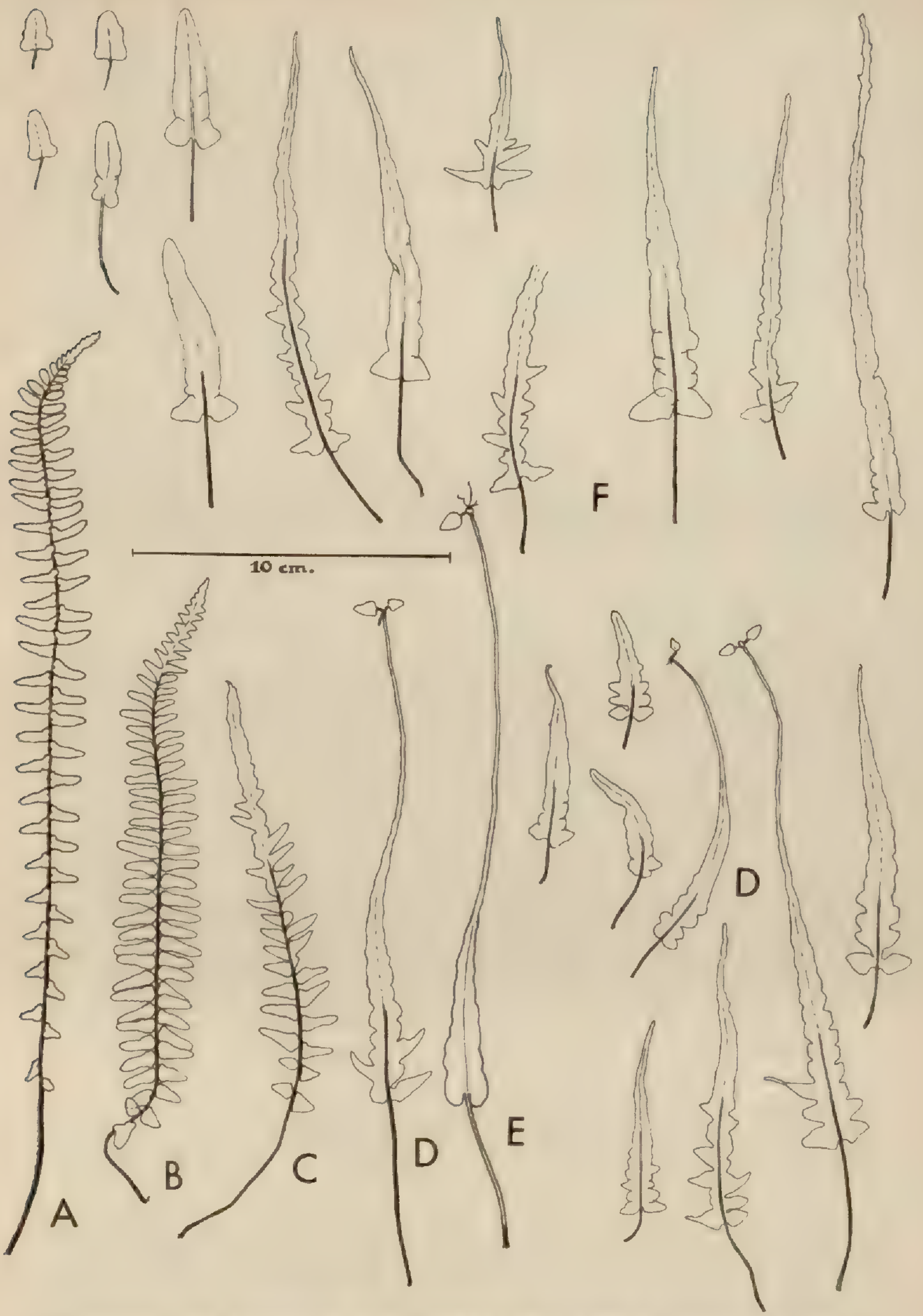
[1] Wagner, W. H. *Asplenium ebenoides* × *platyneuron,* a new triploid hybrid produced under artificial conditions. THIS JOURNAL 46 (no. 2): 75–82, 1956.

[2] THIS JOURNAL, *l.c.*

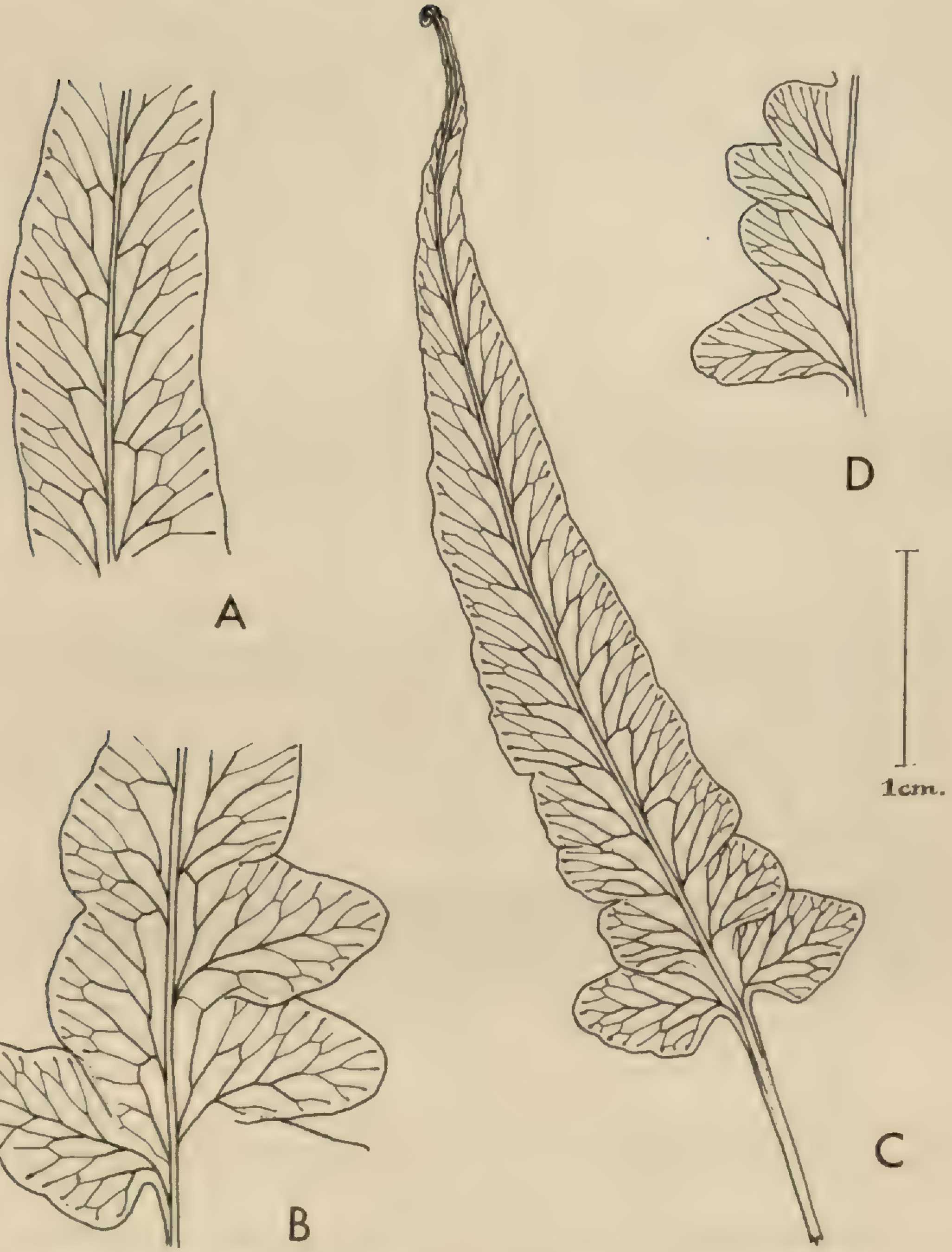
[3] Wagner, W. H. & R. S. Whitmire. Spontaneous production of a morphologically distinct, fertile allopolyploid by a sterile diploid of *Asplenium ebenoides.* Bull. Torrey Bot. Club 84: 79–89. 1957.



Drawings of abaxial side of leaves to show extent of dark coloration on midrib: A. Asplenium platyneuron; B. A. ebenoides × platyneuron; C. A. ebenoides; D. A. ebenoides × rhizophyllum, wild form, Shepherdstown, West Virginia; E. A. rhizophyllum; F. A. ebenoides × rhizophyllum, Fernwood hybrid

latter and from the numerous plants of fertile *A. ebenoides* (Alabama form) grown simultaneously. The spores of *A. ebenoides* had been sent originally by Miss Emma Groff of Lancaster, Pennsylvania. Those of *A. rhizophyllum* were collected originally by K. E. B. at Turkey Run State Park, Indiana. The culture in which the backcross fern appeared was made up primarily of *A. rhizophyllum*, which had been planted on February 9, 1956. The soil which was used in all the culture dishes was a mixture of sand, loam, leaf mold (from a leaf compost pile), with the leaf mold making up one-half to two-thirds of the total amount. The soil was well mixed and then sifted through the fine mesh of a window screen. It was sterilized by baking. A planting of the *A. ebenoides* was made the same day, prior to that of *A. rhizophyllum*, and its spores apparently contaminated not only the latter but another dish containing spores of *A. pinnatifidum*. The backcross hybrid thus resulted from the contamination of the *A. rhizophyllum* dish with some spores of *A. ebenoides*. Only one specimen of the new hybrid developed—this, however, a large and luxuriant plant.

The recognition features of the new backcross are readily perceived, and there seems to be no question that it is a perfect intermediate between the parents. These features may be listed as follows: (1) veins abundantly anastomosing in the majority of leaves, and at least some vein meshes formed even in the most free-veined leaves; the anastomosis of veins is most conspicuously shown in the upper half of the leaf-blade; (2) lobes of the blade few (generally 2 to 8), and only in the basal part of the blade; these are only rarely cut all the way to the midrib; no true pinnae or leaflets (i.e., segments contracted to a petiolule or fully contracted at a sessile base) formed; (3) upper third to one-half of the blade gradually attenuate to a long, tail-like structure, resembling the



Venation patterns of Asplenium ebenoides × rhizophyllum: A. Upper part of blade, Fernwood hybrid; B. Lower (lobed) part of blade, Fernwood hybrid; C. Whole, rather small leaf, wild plant, West Virginia; D. Lower part of leaf showing free-veined extreme, wild plant, West Virginia

blade of *A. rhizophyllum* except for shallow undulations; (4) leaves readily forming new plants at tips, making possible vegetative reproduction of new plants easily; (5) the petiole maroon, the rachis green except in the lower one-fourth or less; (6) chromosome number, 108; (7) spores, unlike the parents, highly variable in size and shape.

It should be mentioned that the original plant of *A. ebenoides* × *rhizophyllum* damped off during the early part of 1957. This did not cause any great problem, however, since the plant had already given rise at the leaf tips to a number of young plants in the manner of the walking fern. Some of these juvenile individuals had not damped off, and one of them quickly grew into another large-sized individual like the mother plant.

The evidence for the origin of a new hybrid, *Asplenium ebenoides* × *rhizophyllum*, would have to be based solely on two lines of reasoning—(a) circumstances of the accidental mixing of the parental prothallia; and (b) the intermediate morphological characteristics of the plant; but because we had living material available for cytological observations we could add an important new line of evidence, namely the number and behavioral features of the chromosomes. Typical *A. rhizophyllum* is a normal species with the $2n$ number of chromosomes, where n (i.e., the number in the sex cells) equals 36. When the spores are produced, the like chromosomes out of the total of 72 pair with each other so that 36 pairs of chromosomes form. The pairs then separate into individual chromosomes which migrate and form new cells ultimately, the spores, with 36 chromosomes each. But typical $2n$ *A. ebenoides*, which is a hybrid between two species, differs in that its two sets of chromosomes come from genetically distantly related plants (*A. platyneuron* and *A. rhizophyllum*). Therefore, at spore production, the chromosomes fail to pair normally, and

there are, thus, 72 single chromosomes. These migrate irregularly, and the resulting spores fail to receive balanced chromosome sets and accordingly abort and are sterile. The fertile form of *A. ebenoides* has double the number of chromosomes, i.e., $4n = 144$; this makes it possible now for each original set from the parents to have a homologous set. The pairing reactions takes place normally therefore, and there are 72 pairs.

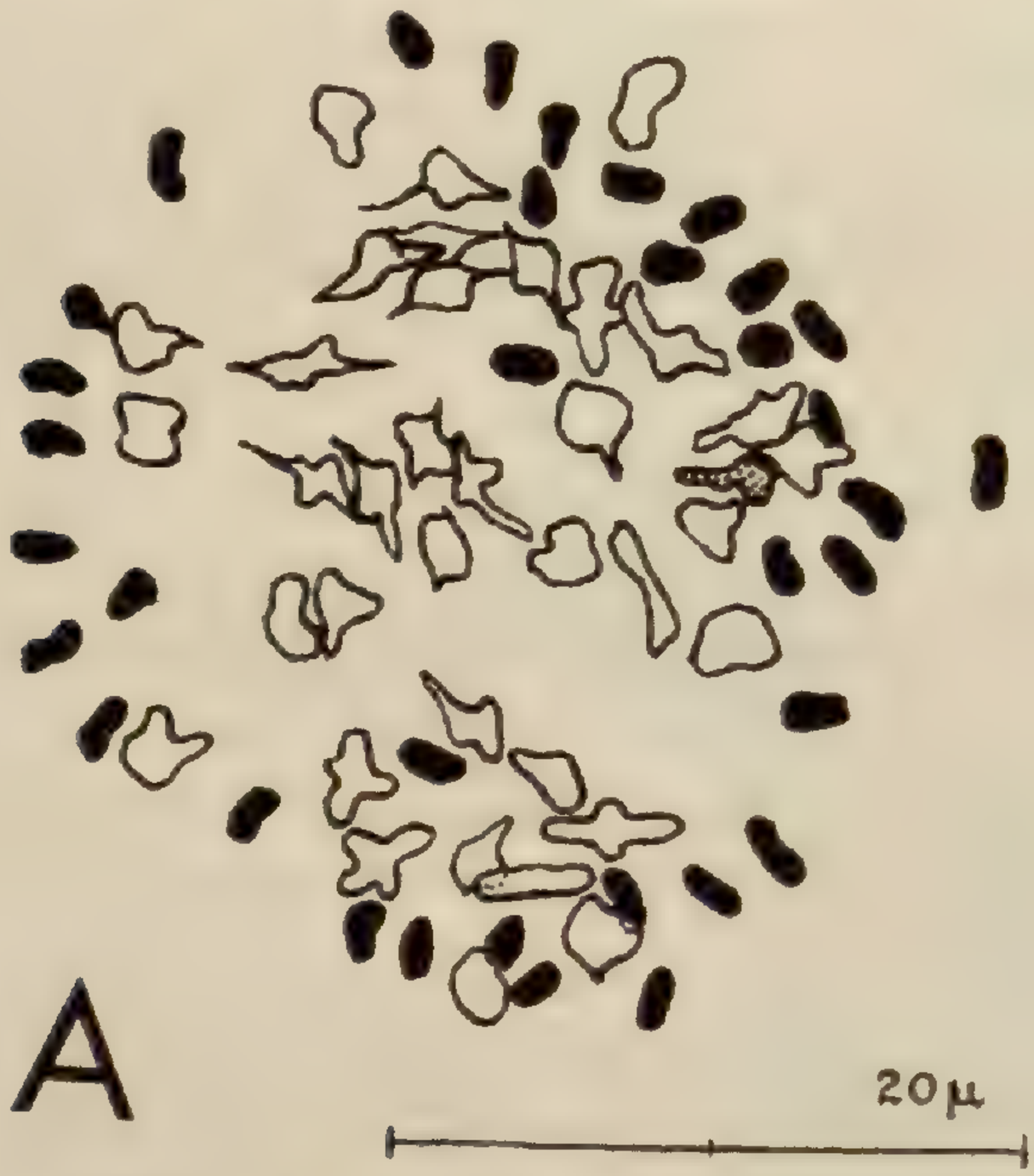


FIGURE A. ASPLENIUM EBENOIDES × RHIZOPHYLLUM. MEIOTIC FIGURE, SHOWING CA. 36 BIVALENTS AND 36 UNIVALENTS: BIVALENTS OUTLINED ONLY; UNCERTAIN FIGURE STIPPLED; UNIVALENTS INKED IN. FERNWOOD, AUGUST 11, 1957

Asplenium ebenoides × *rhizophyllum* differs from all these forms. At spore production we see approximately 36 pairs of chromosomes and 36 single chromosomes (*Figure A*). The chromosome number of the plant is $3n = 108$. This is what would be expected if a sperm (or egg) of fertile *ebenoides* with a "double" chromosome complement made up of one complement (P) from *platyneuron* plus one complement (R) from *rhizophyllum*

fused with an egg (or sperm) of *rhizophyllum* with one complement (R) of that species. Thus, where typical *rhizophyllum* has RR and *ebenoides* has either PR (sterile form) or PPRR (fertile form), the new back-cross hybrid has a chromosome-set formula of PRR. At spore production, when the chromosome number should normally be reduced to half to form spores, the two R sets of chromosomes pair with each other giving 36 pairs

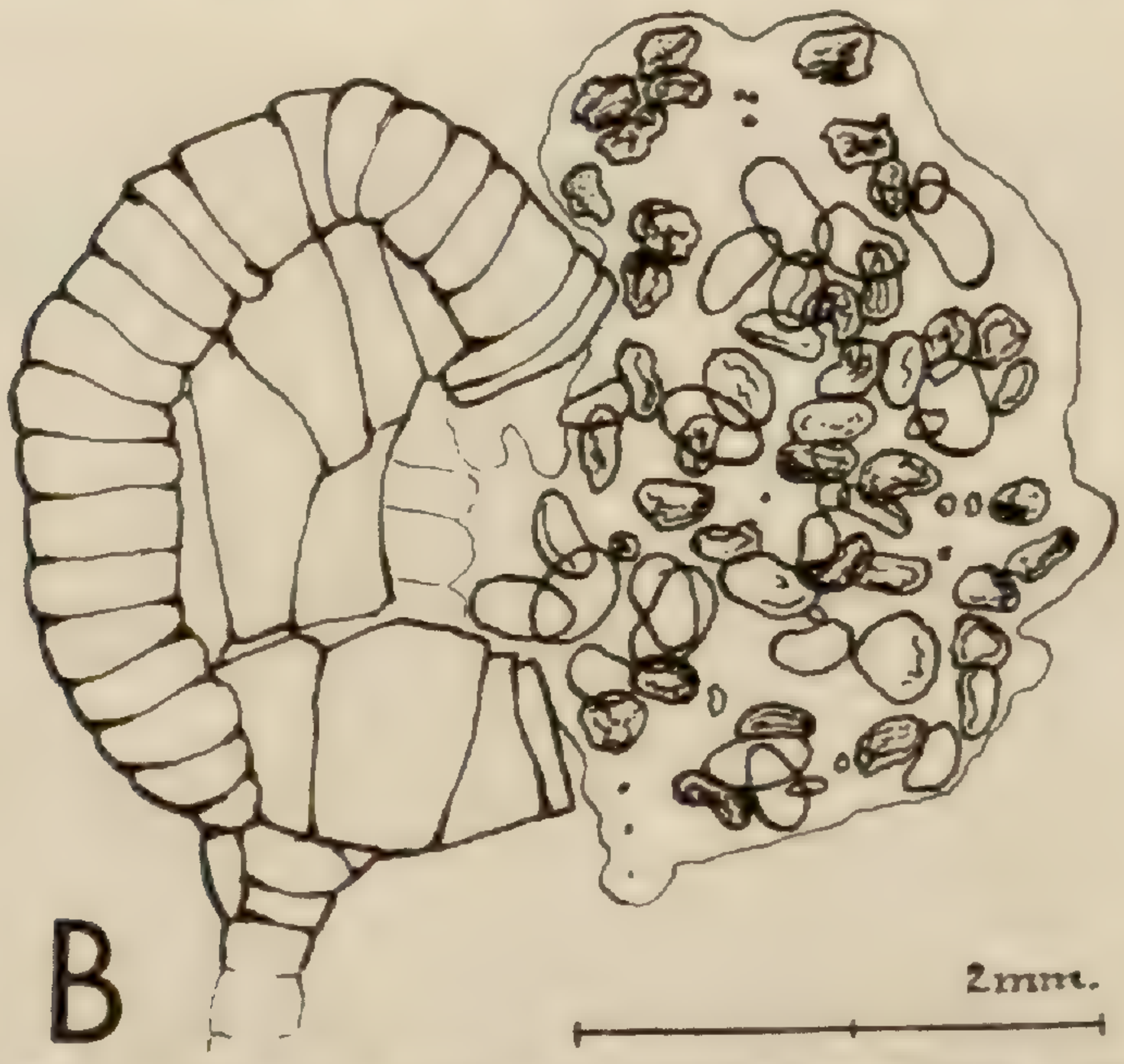
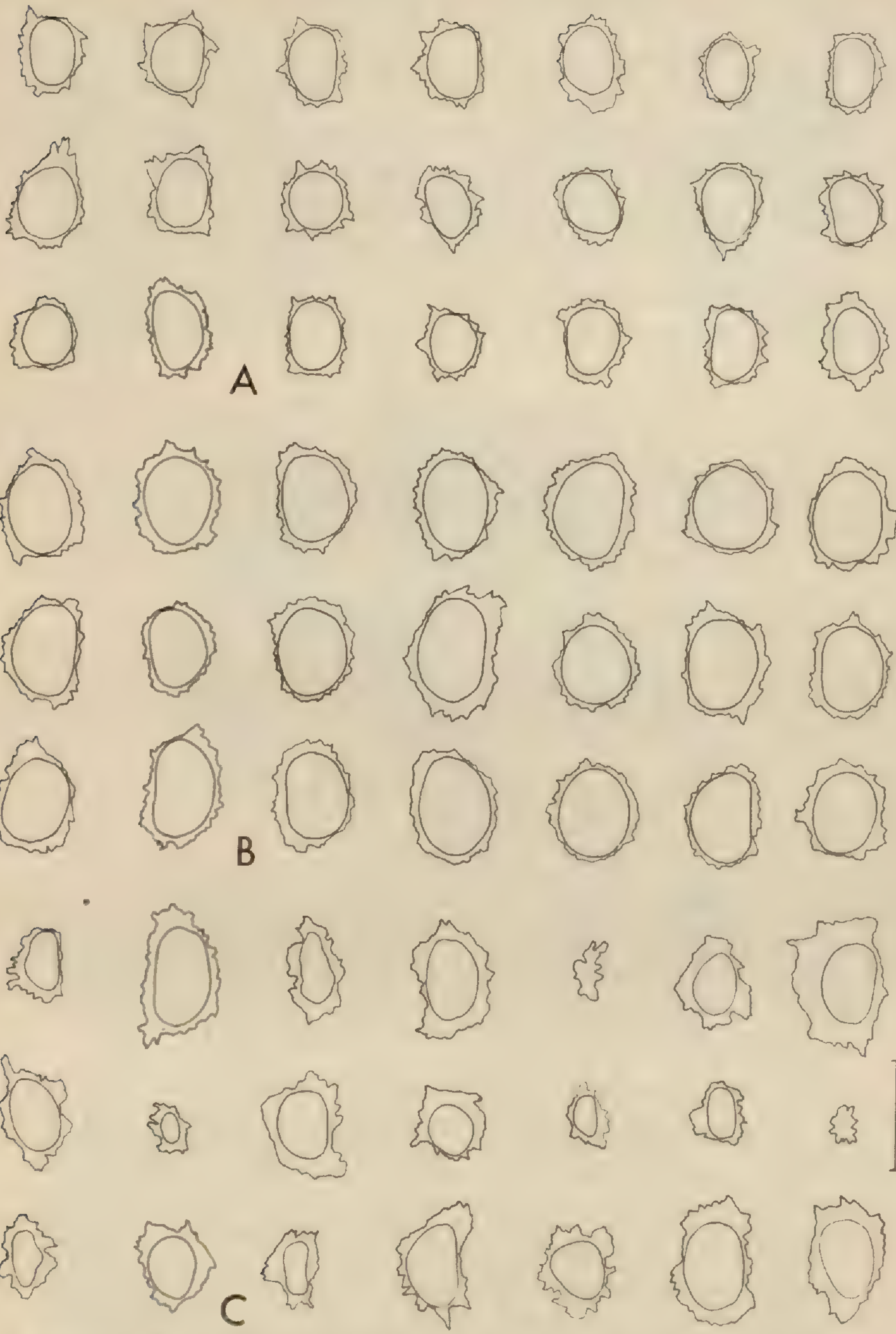


FIGURE B. ASPLENIUM EBENOIDES × RHIZOPHYLLUM. SQUASHED YOUNG SPORANGIUM WITH EXTRUDED SPORES BEFORE DEVELOPMENT OF PERISPORE, GREATLY MAGNIFIED. FERNWOOD, AUGUST 11, 1957

(i.e., two sets of *rhizophyllum* chromosomes) and the one P set gives 36 singles (i.e., only one set of *platyneuron* chromosomes which have nothing to pair with and do not pair with each other).

As might well be expected, the spores of *A. ebenoides* × *rhizophyllum* form very peculiarly because of the unbalanced chromosome situation. In this respect they contrast sharply with the spores of the two other ferns involved in the same culture. The spores of *A. rhizo-*



Spores. Camera lucida tracings of outlines of exospore (the smooth inner line) and perispore (outer rough line). A. Asplenium rhizophyllum, typical ($2n$), near Daggett Fire Tower, Mackinac Co., Mich., Rosa & Wagner 80. B. A. ebenoides, Alabama fertile form ($4n$), Emma Groff. C. A. ebenoides × rhizophyllum, Fernwood, Boydston

phyllum are all normal (as illustrated in *Pl. 19, A*) and each has one R set of chromosomes. The spores of fertile *A. ebenoides* (*Pl. 19, B*) are also all normal but they are larger because they have two chromosome complements each (PR). But those of *A. ebenoides* × *rhizophyllum* are extremely irregular (*Pl. 19, C*). Some of them, to be sure, are reasonably normal-looking, but the majority seem to have peculiarities of one kind or another. Some have distorted shapes. In many of them, the perispores (the rugged outer envelopes) tend to be large and of exaggerated angularity. Many little bodies that seem to be pieces of perispores lie among the more normal spores. Some of the spores are extremely small. The reason for this is that the unbalanced chromosome complements and the irregular pairing behavior lead to asymmetrical chromosome distribution. The daughter spores thus receive various numbers and kinds of chromosomes, a large number of the combinations being so abnormal that the spores do not develop properly at all.

The outlines shown in *Plate 19* represent camera lucida tracings of mature spores upon which the perispore has been deposited over the exospore, which is the wall surrounding the living cell. To show the appearance of a mass of very young spores before the perispores have been formed, a camera lucida drawing is shown in *Figure B*, of a young sporangium which has been squeezed so that the undeveloped spores plus their nutritive liquid have been extruded. It shows that only a portion of the spores have a normal appearance at all; many of them are distorted, or crinkled, many are small, and the picture is wholly different from the corresponding stage in the parents when all the spores have a bean-shaped outline, a smooth exospore, and are very uniform in size.

The Fernwood hybrid has given us a clue to the identification of what is perhaps one of the strangest

Asplenium ebenoides × rhizophyllum. Wild specimens, from moss-covered limestone cliff, Shepherdstown, Jefferson Co., West Virginia, Wagner & Rawlings 2016.

specimens ever found in this group of ferns. In 1946 W. H. W., in company with David E. Rawlings, explored the extensive limestone cliffs near Shepherdstown, Jefferson County, West Virginia, where a number of spleenworts occur, including *Asplenium platyneuron*, *A. ebenoides*, *A. ruta-muraria*, and *A. rhizophyllum*. At this locality, *A. ebenoides* is extremely rare, and only one juvenile plant was found which was taken to the greenhouses at the University of Pennsylvania where it was grown to maturity by Dr. Carroll E. Wood, Jr. Another plant, a fine specimen with a number of full-grown, soriferous leaves, was found growing on a mossy boulder with *A. rhizophyllum*. This specimen was so atypical that it was left unidentified and considered to be related to *ebenoides*, possibly an aberrant specimen. Its characteristics were so much like those of walking fern, *A. rhizophyllum*, that it was certainly not a typical example of *A. ebenoides*. Unfortunately, in illustrating variation of the latter species in an earlier article[4] the senior author figured two of the leaves of this plant as representing an extreme variant. Now, in the light of our knowledge of the Fernwood hybrid, this interpretation must be modified. In all respects, the West Virginia plant matches the Fernwood hybrid: Its veins form numerous areoles, the lobes of the blade are few and shallow, the outline of the blade is like that of *A. rhizophyllum* (and unlike that of corresponding leaves of *A. ebenoides*), all the large leaves form small plants at the apex, and the petiole only is darkly pigmented, the maroon color extending but for a short distance, if at all, onto the midrib beneath. As we have only the dried specimen, we cannot, of course, determine the chromosome situation; the spores, however, are like those of the Fernwood plant, showing the same sort of abortion.

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[4] Reticulate evolution in the Appalachian Aspleniums. Evolution 8 (no. 2): 103–118, *figure 2, A*.

Now, an extremely interesting problem arises. How was this plant, which almost surely is identical with the one produced under artificial conditions, formed in nature? It would seem to require that a fertile population of *A. ebenoides* be near by, to provide the other parent. This, however, was very unlikely. We "scoured" the vicinity very carefully, and there were no populations of fertile *ebenoides* present. Furthermore, we have explored a great distance up and down the Potomac River in this locality, and never found any such populations. How then could this plant have formed? All we can do is to make hypotheses. One possibility is that a diploid spore from the sterile form of *A. ebenoides* had sometime in the past formed a gametophyte, and there was fertilization between this gametophyte and one of *A. rhizophyllum*. This mechanism has already been suggested by an experiment reported earlier.[5] The only other reasonable possibility seems to be that our plant, which in all likelihood matches *A. ebenoides* × *rhizophyllum* genetically, was formed, in fact, by direct hybridization between *A. platyneuron* and *A. rhizophyllum*, but the prothallus of the latter was a diploid one rather than the normal haploid one with one set of chromosomes. In other words, a chance doubling of chromosome number in spore formation (a phenomenon not unknown in plants) could have produced a spore with the formula RR. The gametophyte which grew from this and the sperms and eggs that developed would likewise have RR. Thus, if a sex cell from a *platyneuron* gametophyte with one, normal set, P, fused with one from the peculiar gametophyte of *rhizophyllum*, RR, the result would be genetically essentially identical with the Fernwood hybrid, i.e., it would have the formula PRR. It should be emphasized that either hypothesis could work: either

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[5] Wagner & Whitmire, *op. cit.*

PR × R or P × RR would result in the same plant. Perhaps we shall never know exactly how the West Virginia specimen was produced. It would be desirable to investigate the locality in the future, however. For example, there may be a clone of *A. rhizophyllum* there which is 4*n* in chromosome number. Again, there might be a fertile population of *A. ebenoides* somewhere nearby which we somehow overlooked.

Whatever the case, the West Virginia specimen is unique. It *is not* like any *A. ebenoides* that has ever been reported to our knowledge, but it *is* indeed a close facsimile of the Fernwood hybrid. Thus it is one of the most problematic specimens we have found among the Appalachian aspleniums.

Specimens of both the culture plant and the wild plant will be deposited in the University of Michigan Herbarium and the U. S. National Herbarium.

DEPARTMENT OF BOTANY, UNIVERSITY OF MICHIGAN, ANN ARBOR, AND FERNWOOD, RURAL ROUTE THREE, NILES, MICHIGAN.

An Unusual Form of Asplenium Bradleyi

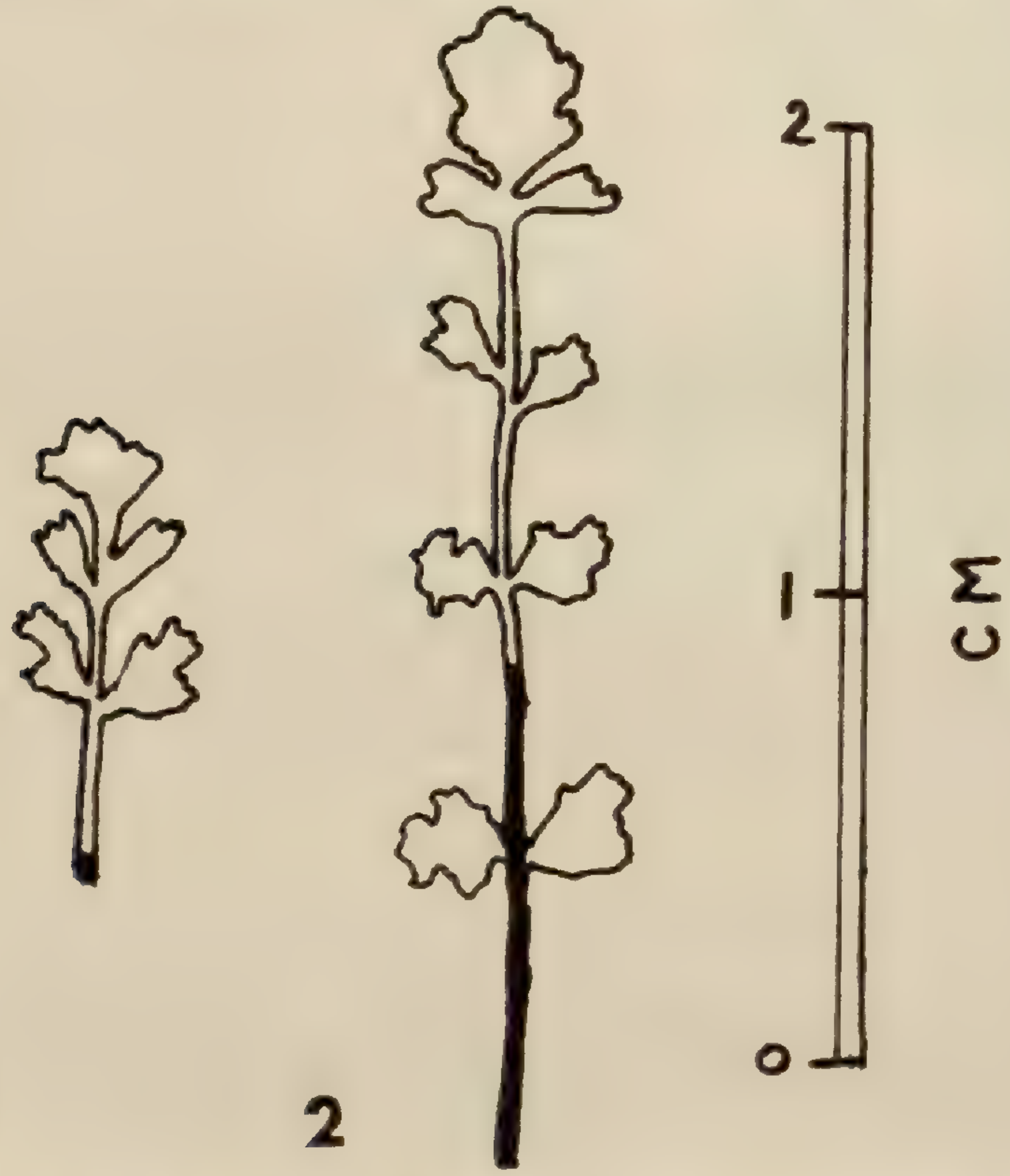
WALLACE R. WEBER AND ROBERT H. MOHLENBROCK

While collecting in a sandstone region of Caseyville rocks from the lower Pennsylvanian epoch in Randolph County, Illinois, the senior author discovered an unusual colony of dwarf *Asplenium Bradleyi* D.C. Eaton growing with the typical variety. The dwarf specimens resemble *Asplenium* × *Gravesii* and even *Asplenium* × *kentuckiense*, but Dr. Warren H. Wagner[1] says that either of these would tend to have the tips less dissected and the lobes rounder than in our specimens.

The unusual character of this dwarf fern, other than its diminutive size, is in the disappearance of pigmenta-

[1] Personal correspondence.

tion in the rhachis (*Fig. 1*), one of the usual diagnostic characters of *Asplenium Bradleyi*. Wagner reports that the disappearance of pigmentation goes hand in hand with dwarfed specimens. However, plants nearly as small as the green-rhachised *A. Bradleyi* occur in the



same area and possess the characteristic partially pigmented rhachis. (*Fig. 2*).

Specimens of the dwarf form are considered mature since they bear numerous crowded sori. Some of the heavily fruiting plants have fronds less than one centimeter long as compared to some of the larger typical *Asplenium Bradleyi* specimens in the area which have as many as eighteen pairs of pinnae!

Dwarf forms of *Asplenium pinnatifidum* and *A. montanum* frequently occur in very exposed microhabitats,

yet in Randolph County typical *A. Bradleyi* grows in areas equally as exposed as the dwarf forms.

COMPARISON OF THE THREE FORMS OF ASPLENIUM BRADLEYI IN RANDOLPH CO.

	Pigmentation of the rhachis	Length of the fertile frond	Number of pairs of pinnae
Mohlenbrock 2491	⅔ its length	22 cm.	18
Weber 425	⅓ its length	3 cm.	3–4
Weber 38	None	1.2 cm.	2

Mohlenbrock 2491 is the typical variety, *Weber* 425 the dwarfed form with normal pigmentation, and *Weber* 38 the dwarfed form with atypical pigmentation. All specimens are deposited in the herbarium of Southern Illinois University.

DEPARTMENT OF BOTANY, SOUTHERN ILLINOIS UNIVERSITY, CARBONDALE, ILL.

Techniques Involving the Sowing of Spores of Ferns for Artificial Culture[1]

BERNARD T. BRIDGERS

Numerous papers have been presented on studies of prothalli of the Filicinae under artificial conditions, and varied techniques have been used for sowing the spores on the substrata. The writer has not found any of these methods to be completely suitable. The object of this paper is to present a technique for sowing the spores which may be found applicable to germination studies as well as studies of growth and development of the prothalli.

Several writers, including Hires (1940) and Steeves, Sussex, and Partanen (1955), have used a bacterial inoculating loop to streak the spores on the surface of

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[1] Reprinted from the Journal of the Washington Academy of Sciences **48**: 158, 159. 1958.

nutrient agar. Mohr (1956) described the use of a soft brush, and Reuther (1953) reported that sowing the spores was made through lens paper.

To obtain a consistent homogeneous and not-too-compact distribution of spores by these methods is difficult. If the number of spores used is considered significant, these methods are impracticable. A method which has been found more satisfactory than the reported techniques involves the preparation of a spore suspension, using sterile water.

After the spores have been collected they are passed through a fine lens paper to remove any foreign matter, such as portions of sporangia. The spore suspension is then prepared. One is able to estimate the amount of spores to be used in a given volume of water and then the relative number of spores is determined microscopically by observing aliquants of the suspension. However, accuracy is facilitated by using a hemacytometer. This instrument enables one to make a more exact count of the spores to be used.

The suspension is thoroughly agitated in order that the spores will become dispersed throughout the medium. Clumping of spores is as common with ferns as with fungi. To insure a homogeneous dispersion of spores Tween 20 may be added aseptically, at a concentration of 5 mg per 100 grams suspension. Then, considering the number of spores desired for the study, a measured amount of the suspension is placed on the medium. A slight rotation of the medium further aids the dispersion of spores.

Practices of disinfestation of spores have been variously discussed. In order to obtain spores free from contaminates, disinfesting the leaf before the opening of the sporangia first was suggested by Perrin (1908) and was later modified by Kleinschmidt (1957). Hurel-Py (1950), however, abandoned the method outlined by

Perrin for a direct treatment of the spores. For studies of germination it is considered wise to eliminate such treatments. As has been discussed by Hurel-Py, variation in species must be considered when selecting a concentration of the disinfestant and time of treatment. When the spores are passed through the lens paper most of the foreign matter is removed, and when sowing the spores is performed under aseptic conditions, contamination is held to a minimum. Considering the fact that germination studies may be completed within ten days after sowing, contamination should not be a problem of too much concern, when an inorganic nutrient medium is used.

For longer-termed studies a disinfestant may be used. Steeves et al. (1955) used a 5 percent solution by weight of Pittchlor (manufactured by the Columbia-Southern Chemical Co., Pittsburgh, Pa.). This is a modification of methods described by Hires (1940) and Hurel-Py (1950). No quantitative data are available concerning disinfestation of spores, and the writer feels that this should be done only with caution.

It is common for some germination to occur over a relatively long period. To facilitate subsequent growth studies and to obtain a uniform beginning-point of development, the spores may be sown on sterile water. Uniformly developing prothalli, for example, at the 15- to 25-celled stage, may then be isolated and placed on the medium being investigated. Hurel-Py (1950) has used a similar technique.

Thus, although the technique of suspension of spores presented in this paper is perhaps not applicable to commercial fern producers, it may be helpful in quantitative studies of cellular physiology and morphology in the laboratory.

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Is It a Hybrid or a Species?

FERN WARD CRANE

There has been a good deal of confusion, especially in the *Dryopteris Clintoniana-cristata-spinulosa* series, regarding the interpretation of a given specimen. Is it a hybrid or a species? The problem may be resolved with a few pieces of equipment and some diligent study.

In order to recognize the characteristic abnormal spores of hybrid ferns, it is necessary first to become acquainted with normal spores from sori of accurately identified specimens of the species involved. The sculptured spores are distinct for each species, and hence they may be compared with data already published.[1, 2]

It is wise to prepare permanent slides, using the medium Permount, and to keep a file for reference and for comparative study. An excellent space-saver for

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[1] Crane, Fern Ward. Spore Studies in Dryopteris. I, II, III. This JOURNAL **43**: 159–169. 1953; **45**: 14–16. 1955; **46**: 127–130. 1956.

[2] Erdtman, Gunnar. Pollen and Spore Morphology and Plant Taxonomy. Vol. II. Gymnospermae, Pteridophyta, Bryophyta. The Ronald Press Company, New York. 1957.

housing the slides is a metal box containing plastic drawers commonly used to store assorted oddments. The resolution of a simple compound microscope is sufficient for spore examination.

After the student has become familiar with the spores of several related species, he may undertake the study of their suspected hybrids. Spores produced by a hybrid fern can be quickly recognized, for a majority of them are tiny and aborted. Normally in any large sampling, however, there are also to be found some unusually large misshapen spores, presumably fertile. These abnormal spores exhibit a combination of the characters of both parents.

It is sufficient for the beginner merely to separate the hybrids from the taxa meriting species rank on the basis of spore features. After one has mastered that phase of research, he may debate the parentage of these puzzling hybrids. Data to be considered specifically are gross morphologic details of the fronds and the microscopic characters of the indusia and abnormal spores.

Study of the specimens in several large herbaria shows that errors are often made in identifying *D. intermedia*, *D. spinulosa*, and their hybrid "var. *fructuosa*." In these collections, too, *D. Clintoniana*, *D. cristata*, and their hybrid have been misinterpreted, yet the spores of each of these entities are distinctly characteristic. Curators of herbaria might well set aside unneeded extra sheets from *Dryopteris* collections for student work. Amateurs, too, will find this type of research interesting as well as useful in annotating their own specimens.

174 SUMMIT AVENUE, SUMMIT, N. J.

Shorter Note

A RARE FORM OF THE DEER-FERN.—The Deer-fern, *Blechnum spicant*, normally has the pinnae quite entire. In 1911, Willard Clute described f. *bipinnatum*, a striking variation in which the pinnae, or most of them, are

deeply pinnately lobed above the middle (although the blades are not *quite* bipinnate, as the formal name implies). This variant was collected at Uclulet, on Vancouver Island, British Columbia, by a Mr. George Fraser about 1906 or 1907. According to Clute, Mr. Fraser moved his find to his garden, and it reverted to the normal type the following year. However, he says also that some spores that were sent to England were reported to have reproduced some plants of the new form. On August 25, 1957, I found f. *bipinnatum* in California, a new record for the state. There was a single large plant growing in Little River State Park, Mendocino County; all the fronds on the plant were lobed.

Later I found a colony of another form of the Deer Fern growing in Van Damme State Park, Mendocino County, California. There were at least seven plants of this form, which differs in having the segments only toothed rather than deeply lobed. A similar plant was found in western Oregon by Thomas J. Howell in 1880 and distributed by him as "var. *serratum*." It is represented in the Dudley Herbarium and the U. S. National Herbarium. This plant was growing in mixed redwood and pine forest, along with the Western Sword-fern (*Polystichum munitum*) (growing over 6½ feet tall), Maidenhair-fern (*Adiantum pedatum*) (over three feet tall), Coast Nettle (*Urtica californica*), and various mosses, among them *Plagiothecium undulatum*, *Eurhynchium oreganum*, *Mnium medium*, and *Neckera Douglasii*.

Specimens of both the new collections mentioned have been deposited in the U. S. National Herbarium.—DONALD BRANSCOMB, *Willits, California.*

Recent Fern Literature

FOLK-LORE OF FERNS is the subject of an article[1] by Dr. Alice F. Tryon in the current number of "The Herbal-

[1] The Herbalist, no. 24: 7–14. 1958.

ist,'' the publication of The Herb Society of America. Ferns have many uses—for food (fiddleheads of Ostrich Fern, rootstocks of Bracken), in medicine (Male Fern and Polypody as an anthelmintic), as building material (trunks of tree-ferns), in decorative designs (for wall-paper and fabrics), and as themselves (living in gardens and greenhouses or dried for winter decorations). These are the subjects of Mrs. Tryon's interesting and well-written article.—C. V. MORTON

Our member Barbara Joe (Mrs. T. Hoshizaki, 565 North Westmoreland, Los Angeles 4, California) has started a series of publications on the ferns cultivated in California. The first of these, entitled "*Pteris* species cultivated in California,"[1] discusses and illustrates the seven species of brakes that are known to be cultivated in southern California. The second paper, entitled merely "Ferns cultivated in California,"[2] discusses the chain-ferns (*Woodwardia*), the gold and silver ferns (*Pityrogramma*), and *Aglaomorpha*, a tropical genus of ferns as yet lacking an English name. Mrs. Hoshizaki has a few reprints of these papers available for interested readers.—C. V. MORTON

Notes and News

July 13, 1958

Dear Mr. Morton:

I would appreciate identification of the enclosed fern. It is in cultivation in the Miami area under a number of common names. Some nurserymen believe it is native.[3]

During the past few months I have observed some ferns that may be of interest to American Fern Journal read-

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[1] Lasca Leaves 8: 26–29. 1958.

[2] *Ibid.*, 60–65. 1958.

[3] It is *Polypodium scolopendria* Burm., a native of Asia and Polynesia. C.V.M.

ers. I found specimens of *Cheiroglossa palmata* growing within a few feet of a busy highway south of Miami. Also, I observed this uncommon fern on a cabbage palm near Fort Pierce, Florida. In Palm Beach County, I saw a thriving colony of *Ceratopteris thalictroides* which had been introduced in a pond and had spread to neighboring drainages of ditches and streams. Last fall I found a colony of *Sphenomeris clavata* in a lime sink in pinelands on Big Pine Key. Last week when I revisited the site a fire had swept the rocky pineland and scorched most of the plants in the sinkhole. It may have eliminated some of the *Habenaria* orchids growing on the edge of the hole. However, the *Sphenomeris* was making a comeback despite some severe damage.

Yours sincerely

Curtis F. Dowling, Jr.
35 North West 24th Court
Miami, Florida

TWO QUESTIONS:

Does it injure a fern or affect the next season's growth to cut the green fronds? My wife finds some of them, particularly the polystichums, attractive in flower arrangements. The polystichums of the Pacific Northwest are being extensively cut for this purpose commercially.

Why is it that the botrychiums are so hard to transplant? Even when carefully dug up to preserve the long deep roots, they seem to last only one season. This applies to my fern garden in New Hampshire, where grape and rattlesnake ferns have been moved from nearby woods to a similar soil.

BENJAMIN R. ALLISON
Hewlett, Long Island, New York

Professor Wilhelm Herter, who contributed an article on Central American *Urostachys* (*Lycopodium*) to the

last number of the Fern Journal, died in Hamburg April 17, 1958, aged 74 years. Some biographical data will be found in Darwiniana **1**: 154–158. 1924. He was born in Hamburg, Germany, January 10, 1884. He was a long-time resident of Uruguay, where he collected and distributed plant specimens copiously between 1924 and 1950. A rather complete set (about 2800 numbers) of these herbarium specimens (which bear the title "Plantae Uruguayenses Exsiccatae") is in the herbarium of the Institut für Spezielle Botanik, Zürich, and another large set (about 2500 numbers) is in the Conservatoire et Jardin Botanique, Geneva. The United States National Herbarium has a partial set, acquired by purchase some years ago. Herter's personal herbarium was in part (about 30,000 sheets) in Berlin, where it was destroyed by fire during the last war; the remainder of his collection, numbering about 50,000 sheets, is still in Montevideo, but there are plans to transfer it to Basel. Herter was the founder, editor, and chief contributor to the "Revista Sudamericana de Botanica," of which 10 volumes were issued. Dr. Paul Aellen and the undersigned tentatively plan to continue this publication, under the title "Revista Botanica." In recent years, Prof. Herter's principal contributions to botany have been in studies of the genus *Lycopodium* (and the segregate that he calls *Urostachys*); he published a useful "Index Lycopodiorum" in Montevideo in 1949.—H. P. FUCHS.

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Truth is the foundation and the reason of the perfection of beauty, for whatever stature a thing may be, it cannot be beautiful and perfect, unless it be truly what it should be, and possess truly all that it should have.—ALFRED NORTH WHITEHEAD.

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ERRATA

Page 32, line 14: Delete the whole line and substitute *Asplenium oosorum* Baker, Journ. Bot. Brit. & For. 343. 1876.

Page 119, running head: For "Saccoloma Wercklei," read "Ophioglossum pendulum."

Page 121, running head: For "Saccoloma Wercklei," read "Ophioglossum pendulum."

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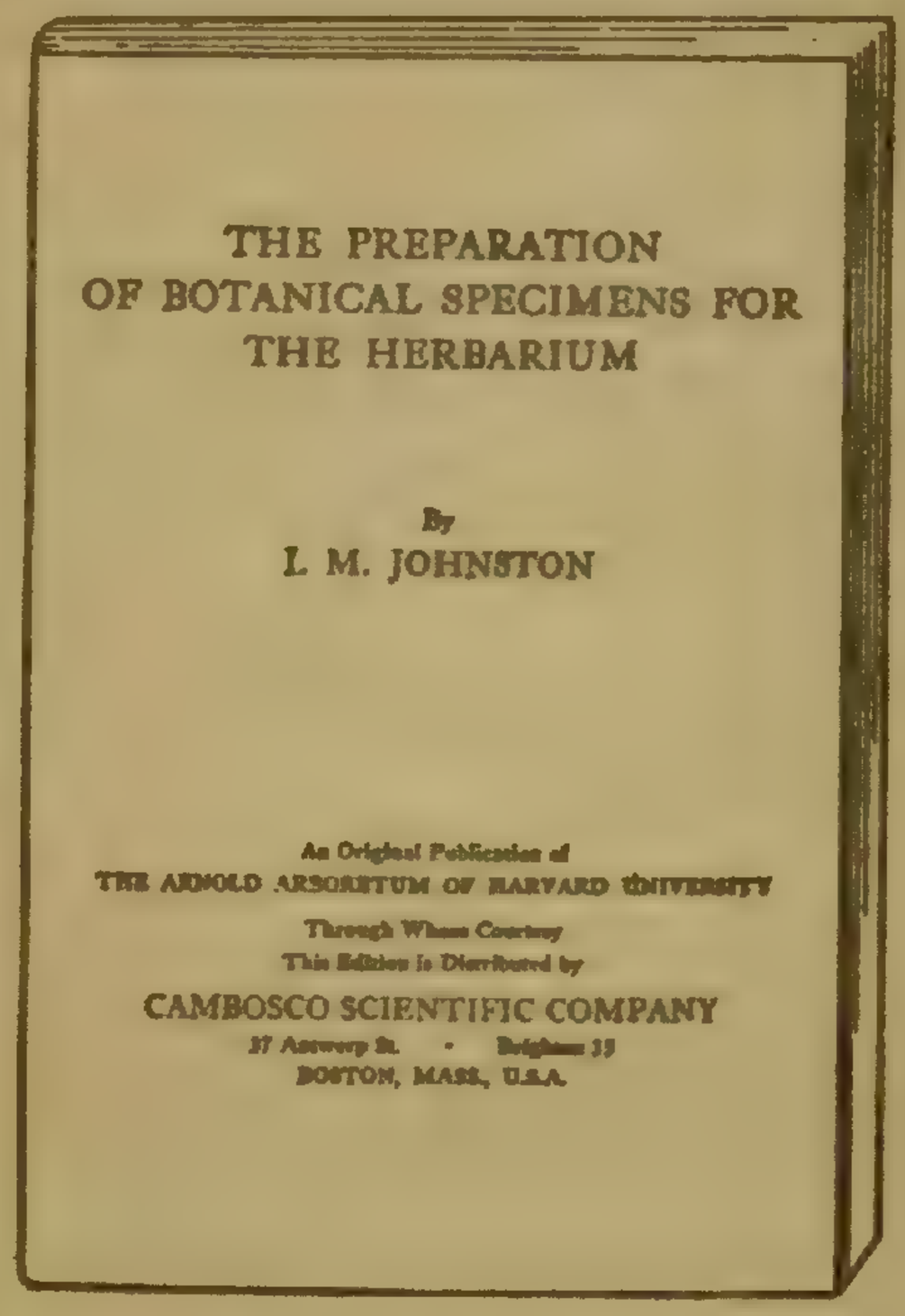

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A QUARTERLY DEVOTED TO FERNS

Published by the

AMERICAN FERN SOCIETY

EDITORS

C. V. MORTON

R. C. BENEDICT IRA L. WIGGINS

A. C. SMITH

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American Fern Journal

VOL. 49 JANUARY–MARCH, 1959 NO. 1

A. H. G. Alston, 1902–1958

C. V. MORTON

Mr. Arthur Hugh Garfit Alston died suddenly in Barcelona, Spain, March 17, 1958.[1] He was the youngest son of the Rev. F. S. Alston, of Scrivelsby, Lincolnshire, and was educated at Marlborough and at Lincoln College, Oxford, where he took an honours degree in Botany in 1924. After a few months' study at the Kew Herbarium, he was appointed Systematic Botanist to the Department of Agriculture at Peradeniya, Ceylon, where he remained for several years, preparing a supplementary volume to Trimen's Handbook to the Flora of Ceylon and the Kandy Flora (published in 1931 and 1938).

In 1930, he was appointed Assistant Keeper in the Herbarium of the British Museum (Natural History), to take charge of the Pteridophyta, where he remained for the rest of his life. He quickly acquired a world-wide knowledge of ferns and their allies, and he improved the Museum's collection of ferns to a remarkable degree, not only by encouraging botanists and explorers of all nations to send in material but also by incorporating photographs of type specimens deposited in the many foreign herbaria that he had visited. Botanically, he will be remembered chiefly as an authority on the genus *Selaginella*, on which he published many papers. Just before his death, he had completed an account of the ferns of West Tropical Africa, which will be published later.

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[1] Most of the following information, kindly supplied through the Rev. E. A. Elliot, comes from The Times [London], March 28, 1958.

[Volume 48, Number 4, of the JOURNAL, pp. 129–176 was issued January 20, 1959.]

Alston was himself an enthusiastic traveller and collector. In 1938 and 1939, he made a very large collection in the Andes of Venezuela and Colombia, and in 1953 and 1954, at the invitation of the Government of Indonesia, he explored Java, Sumatra, Borneo, and Celebes. Nearer home, he made large collections in southern Albania, Greek Macedonia, Algeria, Spain, and Sweden, and shorter holidays were always spent botanizing in the British Isles. During the last war he was assigned to the Ministry of Home Security. In 1946 he was given the important task of reporting on the state of taxonomic botany and the botanical collections in some areas of Germany on behalf of the Allied administration.

Alston put his scholarly mind and profound knowledge of ferns and the history of botanical collectors at the disposal of countless visitors to London. He was a member of the Savile Club and of the Athenaeum, and had been a vice-president of the Linnaean Society of London and of the Botanical Society of the British Isles. At the time of his death he was president of the British Pteridological Society. His loss will be deeply felt, not only in Great Britain but throughout the world.

The Fern Dell, Los Angeles

W. C. Drummond

The Fern Dell, one of the show places that visitors ask to see on arriving in Los Angeles, is a part of the Los Angeles municipal park system. It is located at one side of mountainous Griffith Park, of which it is a part, and is not far from the center of the city of Los Angeles and only about a mile and a quarter from the center of Hollywood. It is maintained by the Los Angeles City Recreation and Park Department, the officials of which are aware of the great interest that there is in the beauty of the Dell and who cooperate in every way in furthering its development. After seeing the Dell, it is little wonder

that visitors come away with a respect for the natural beauty of ferns as well as for the handywork of man.

The Fern Dell was established in 1912 by Frank Shearer, who was then Park Superintendent of Los Angeles. At that time, what is now the Dell was called Western Avenue Canyon, although it had been called originally Mocohuenga Canyon by the Indians. It was Mr. Shearer who first saw the possibility of planting ferns in the canyon. After removing rocks and tree stumps, he built a road through the dell in 1914. The Montgomery Brothers, from New Zealand, were experts in building rock gardens, and they were hired by Mr. Shearer to arrange dams and to create terraced pools through the lower part of the canyon. In 1916, a path was constructed along the stream and dry rock-walls were built to retain the earth, in this way creating an ideal place for the planting of ferns. About this time, Mr. Walt Lambert was the Assistant Superintendent of Parks, in charge of the municipal nursery. He also became interested in the development of the Fern Dell and collected and planted many evergreen ferns suitable for growing in the climate of southern California. He employed Mr. Harry Johnson to assist with the work, who contributed much from his knowledge of ferns gained while living in Peru and other parts of the tropics. These men planned the Dell as we know it today.

The Fern Dell proper is about 1,500 feet long and approximately 300 feet broad; it contains in all about four and a half acres. It is situated along a winding brook, with many small waterfalls, along which is a broad, shaded walk, with benches for resting and viewing the ferns. Besides ferns, the dell has plantings of many shrubs and trees, both native and exotic, most of which are evergreen although a few are deciduous. These trees provide the shade so necessary for the growth of many ferns.

The climate of Los Angeles is subtropical, the days in

View in the Fern Dell, Los Angeles

summer averaging 78° F and in winter 68° to 70°. The summer nights average 64° and the winter 45°. Mornings are often cloudy or foggy, but there is sunshine from late morning to sunset. In the Dell, there is frost about every 10 to 15 years sufficient to kill tender vegetation. Slightly elevated locations with good air circulation may escape the frosts when lower elevations may have it. The Fern Dell is located at the foot of a mountain and has a gradual slope and thus good air circulation. The daytime temperature in the Dell averages a few degrees cooler than the surrounding built-up territory. The average annual rainfall is 15 inches, which occurs mostly in the winter, during the months of December, January, February and March, although there is occasionally some rain in November. During the rest of the year, irrigation must be resorted to; in the Dell, overhead watering is used.

Ferns from all parts of the world are now planted in the Fern Dell. They are mostly evergreen in the climate of Los Angeles, and those listed below seem hardy. The oldest and best-developed are the arborescent kinds. The Australian Tree-fern, *Alsophila Cooperi*, is perhaps the commonest and most impressive; at present, these ferns, planted about 30 years ago, stand 15 to 20 feet tall; they have usually passed under the name *Alsophila australis* in southern California. Those known as Hawaiian Tree-ferns belong to the genus *Cibotium*. They are imported as bare trunks, devoid of an established root system; it takes them a year or more to start growing. These trunks arrive in various lengths from three to ten feet or more. In the Dell they are still in the testing stages, our plants being about four years old. There are two species of these, *C. Chamissoi* and *C. Menziesii*. They are also grown from spores, and once established they do well in the Fern Dell. A related species, the Mexican Tree-fern, *Cibotium Schiedei*, is grown from spores; it eventually reaches a height of 10 to 15 feet, but it is a

little slow and tender at the start; it is the species most commonly grown in tubs for ornament. One of the finest tree ferns is *Dicksonia antarctica*, which is very hardy and long grown in the Dell; it forms large crowns.

Two other ferns that are not really "tree-ferns" but which are somewhat arborescent are the two species *Blechnum brasiliense* and *B. gibbum* (this known also commonly as *Lomaria gibba*). They have low trunks up to 2½ feet high, and seem hardy.

Among the attractive larger trunkless ferns are the Microlepias, both *M. platyphylla*, a large showy background fern up to 5½ feet high, and the smaller *M. strigosa*, which forms large clumps up to 3½ feet high; both species are much planted in the Dell and are among the most conspicuous plants; they seem hardy. The Holly-fern, *Cyrtomium falcatum*, is well established here, growing 2 to 3 feet high; some of the cultivated variants are also grown—cv. 'Mayi,' with crested fronds, cv. 'Butterfieldii,' and the Rocheford-fern, cv. 'Rochfordianum,' with variously cut leaflets; these ferns all grow well in the Dell; they are evergreen, tufted, with clumps of erect fronds up to 2 feet high. Several species of "shield-ferns" and "wood-ferns" are grown. *Dryopteris atrata* (known in the trade mostly as *D. hirtipes*) is a tufted, erect fern up to 2 feet high that does best in shade. *Thelypteris gongylodes* (also known as *Dryopteris gongylodes* and *Cyclosorus gongylodes*) grows best with plenty of light or even in part sun, as does also *T. dentata* (which has passed under the names *Dryopteris dentata*, *Cyclosorus dentatus* or sometimes erroneously as *D. parasitica*); the latter, sometimes called the Downy Wood-fern, is tufted yet spreads by stolons; the fronds are quite erect and up to three feet high. *Thelypteris setigera* (*Dryopteris setigera*) is a beautiful plant with arching fronds 3½ or 4 feet long.

Some of the other important kinds grown in the Dell are the Leatherleaf-fern, *Rumohra adiantiformis* (usu-

ally known in the trade as *Polystichum coriaceum* or *Aspidium coriaceum*), with spreading, shining fronds to 2½ feet long, which grows well in the Dell but best in not too dense shade, and *Tectaria cicutaria,* a tufted plant to 3 feet high, with viviparous buds that drop off and soon grow into new plants; the latter also grows best in not too dense a shade. *Ctenitis pentangularis* has until recently been erroneously known as *Dryopteris decomposita;* it is a tough, leathery fern, forming nice clumps of a deep green color; it is lower growing, reaching only about 18 inches. The fern usually known as *Polystichum setosum* locally is much used in the Dell; it is dark, shining green, tufted, and with a spread of 2 to 2½ feet; the proper botanical name remains to be determined.

Several kinds of brakes do well in the Dell, the tallest and most conspicuous being *Pteris tremula,* which can stand much sun, although it does best in the shade; this kind grows 3½ feet high. Another coarser species is *P. vittata* (often called *P. longifolia*), also more or less a sun plant. Many of the cultivated variants of *Pteris cretica* have been tried, among them cv. '*Parkeri*' (*Pteris Parkeri* of the trade), which grows 2 to 2½ feet high, and cv. '*Ouvrardii*' (*Pteris Ouvrardii* of the trade), lower growing. The two Cliff-brakes *Pellaea viridis* (from South Africa) and *P. falcata* (from New Zealand) are low-growing kinds of which many plantings have been made.

A recent introduction from Mexico, *Llavea cordifolia,* seems perfectly at home. Evidently it likes heat, as it grows best in the summer. It has light yellow green foliage, 18 inches high in the shade. *Polypodium aureum* (also known as *Phlebodium aureum*) is normally an epiphyte in its native habitat in tropical America, but here it grows in shade under trees in a fibrous soil. Another tropical American species, *Blechnum occidentale,* forms clumps 14 or 15 inches high; it spreads by stolons.

The European Hart's-tongue Fern, *Phyllitis Scolo-*

One of Several Bridges across the Creek in the Fern Dell

pendrium, comes in many forms, all of them low growing; it requires shade and does best in limy soils. Another European introduction is the European Chain-fern, *Woodwardia radicans*, which has large, drooping leaves provided with viviparous buds on the rachis, which may be used for propagating the plant.

Some of the native Californian ferns are also grown in the Fern Dell. Among them are the Pacific Sword-fern, *Polystichum munitum*, which makes fine specimens in shade, with dark green, shining, arching fronds, *Dryopteris arguta*, the California Shield-fern, which does best on the hillside without much summer watering, and the Pacific Chain-fern, *Woodwardia fimbriata* (formerly known as *W. Chamissoi*), the largest of western ferns. with fronds up to four feet long similar to those of the European Chain-fern, but lacking the viviparous buds. The Western Bracken, *Pteridium aquilinum* var. *pubescens*, grows well in the shade and also in the sun; it is a rather large, coarse plant. The native California Polypody, *Polypodium californicum*, is not too successful in cultivation; it usually goes dormant in the summer, and so only a few plants are being grown. *Polypodium Glycyrrhiza* grows naturally in the Dell among the native shrubs, but it is not cultivated. The Maidenhair-fern, *Adiantum pedatum*, is not much grown.

It has been my privilege to act as special adviser for the Fern Dell in recent years, and I have also assembled a fern herbarium displaying all the ferns known in cultivation around Los Angeles. This display is housed in the small natural history museum located in Griffith Park, near to the Fern Dell; it is open to the public. The Los Angeles Fern Society, recently organized, of which I am Vice-President, holds its meetings in the museum on the fourth Thursday of each month. Visitors are welcomed.

1246 North Kings Road, Los Angeles 46, California.

Ferns of the Incas

ALICE F. TRYON[1]

How do we know the Incas? From reports of the chroniclers—the soldiers, governors, and priests who came to conquer, and the subsequent observers; from the silent testimony of ruins—fortresses, temples, dwellings, graves, and trash piles; and from the customs and manners of Andean people still remote from modern civilization. All that we know of the ancient Peruvian cultures is from these three sources. I pursue them in this venture among the ferns.

A compilation of the plants in the chroniclers' accounts has been made by Fortunato Herrera and Eugenio Yacovleff in their paper, El Mundo Vegetal de los Antiguos Peruanos. The earliest of these in which a plant, Maíz, can be recognized with certainty is a letter written in 1533 by Hernando Pizarro, brother of the conqueror, Francisco, giving his impressions of the country and people. I have examined the records cited by Herrera and Yacovleff containing references to ferns except for the earliest, an anonymous paper, Relaciones Geograficas sobre Quito, 1573. Here "Doradilla" is mentioned and has been identified as *Notholaena nivea*. In reference to "Trembladera" they quote the original work and I translate—"In the region of Quito there are always herbs although much taller in warmer places than in cold, and withered in summer, except an herb called trembladera, which is more or less a yard in height; it has nodes and internodes similar to fennel and its branches although thicker . . ." and they identify this as either *Equisetum bogotense* or *E. giganteum*. From the general size and comparison to fennel this would seem to be the latter, or

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[1] For the use of Peruvian literature, archeological collections, and fern specimens assembled at the University of California and the many kindnesses shown me by the Herbarium staff, I am most grateful.

perhaps *E. xylochaetum,* rather than the smaller species *E. bogotense.*

The chronicler Garcílaso de la Vega, sometimes referred to as the Inca, for he was the son of an Inca princess and a Spanish soldier of some rank, wrote the Commentarios Reales issued between 1609 and 1617. A few but significant plants of the Incas as Ccantu, *Cantua buxifolia,* the national flower of Peru, and Palo de Balsa, *Ochroma piscatoria,* are included in this account of the life and customs of the Incas. The herb "Viñay Huayna" is noted as signifying always young, from its habit of remaining green for a long time even though dry; it is carried only by persons of royal blood. The leaf is compared to that of the Lily and is placed on the head. In Quechua, both *Lycopodium complanatum* and the orchid *Epidendrum ybaguense* are called "Huañaihuaina" but the comments pertaining to the leaves would seem to identify this as the orchid rather than the minute-leaved *Lycopodium.*

Fr. Bernabé Cobo is reputed to be among the best of the chroniclers for his accounts on natural history. He resided in Lima and Cuzco, traveling thereabouts and northward to Mexico. His Historia del Nuevo Mundo was completed about 1653 but first printed between 1890 and 1893 by the Sociedad de Bibliófilos Andaluces in Seville. Among the plants he mentions are "Polipodio," "Culantrillo de pozo," "Doradilla," "Escolopendria," and "Trembladera." He notes that the roots of "Polipodio" are especially used by the Indians as a decoction with two or three seeds of "Vilca" [*Piptadenia colubrina*] when they are afflicted by phlegm or cholera and the disposition is relieved with ease and without pain or nausea. The "Trembladera" he observed grows in marshes and moist places in temperate lands. Some of the Spanish impatience with the Indians can be detected in his comments that they recognize the plants and give them

Above: Cheilanthes scariosa, "Kumu-kumu"; fronds covered with silvery scales. Below left: Polypodium crassifolium, "Anga-pfurum"; "Bird-feather, in allusion to the feather-shaped fronds. Right: Notholaena aurea, "Cuti-cuti"; prepared as a tea

names in their language but have little curiosity about cultivating them, even though they are useful in their sustenance and in treatments of pain and disease. Herrera and Yacovleff remark on the difficulty of identifying the species from Cobo since they are without sufficient description; they related them to the more conspicuous species in the flora. The "Polipodio" is indicated as either *Polypodium angustifolium*, *P. pycnocarpum*, or *P. crassifolium*. The genus is a large one in Peru, for in the vicinity of Cuzco there are at least twenty species with the characteristic polka-dot sori which might be applied here, and it is likely that several of these species were used. "Culantrillo de pozo" is identified as *Adiantum Poiretii*, "Doradilla" as *Notholaena nivea*, and "Escolopendria" as an *Asplenium*.

The period of conquest and lust for gold recorded by the chroniclers was followed by one of exploration in which the plants were objects of interest. Documenting these years are the collections and records of the Spanish botanists Ruiz and Pavón. A captivating account from the diary of Ruiz reports the Travels of Ruiz, Pavón, and the French botanist Dombey in Peru and Chile between 1777 and 1788 and notes the uses of many of the plants they saw and collected. Some 30 species of ferns are listed among the plants in the region of Tarma and some uses and Inca names are given. There is a note on the kinds of "Calaguala," including *Polypodium crassifolium*, which is called "Puntu-puntu" or "Lengua de ciervo"; it was used as an infusion or decoction of the roots for pains of the sides. It was gathered in Peru and sent to Europe under the name "Calaguala gruesa."

The notable British authority of this period Sir Clements R. Markham translated many of the early manuscripts on Peru and traveled extensively in the country while superintending the collections of Chinchona plants and seeds for introduction into India. His general remarks on the vegetation are of botanical inter-

est. The two references to ferns are not sufficient for determination. He describes the herb vendors at Lampa in the department of Puno and a fern they sell called "Racci-racci," used as an emetic. While in the valley of Tambopata, Markham's Quechua guide pointed out a small *Asplenium* called "Espincu," which has a sweet taste and is sometimes chewed by the Indians for want of "Coca."

The work of the prominent Peruvian physician Hermilio Valdizan, in collaboration with Angel Maldonado, La Medicina popular Peruana, in 1922, surveys the medicinal uses of plants in various departments of the country. *Polypodium angustifolium* is named as a kind of "Calaguala" which is prepared as an infusion of the rhizomes and used in nearly all parts of the country as a purge, to induce sweating, to curtail fevers, malaria, and to treat shock. There are several references to studies of "Calaguala" including that of the botanist Ruiz. "Sano-sano" is identified as a tree fern *Alsophila* from which a glutinous substance exuded from the stems is gathered and applied to heal wounds or in a decoction as an astringent. *Adiantum Capillus-veneris* is recognized as the "Culantrillo de pozo" but it is noted that several others are taken under this name, used as a diuretic and pectoral. *Notholaena Fraseri* is given as the "Doradilla" (but it is more likely that this is *N. aurea*, because of the scarcity of the former), which is gathered in the Andean cordillera but used throughout the country to induce sweating and to treat dropsy. *Equisetum xylochaetum* and *E. giganteum* are given as species of "Trembladera" or "Cola de caballo" and are used in the treatment of ulcers, acne, and highly regarded as a diuretic.

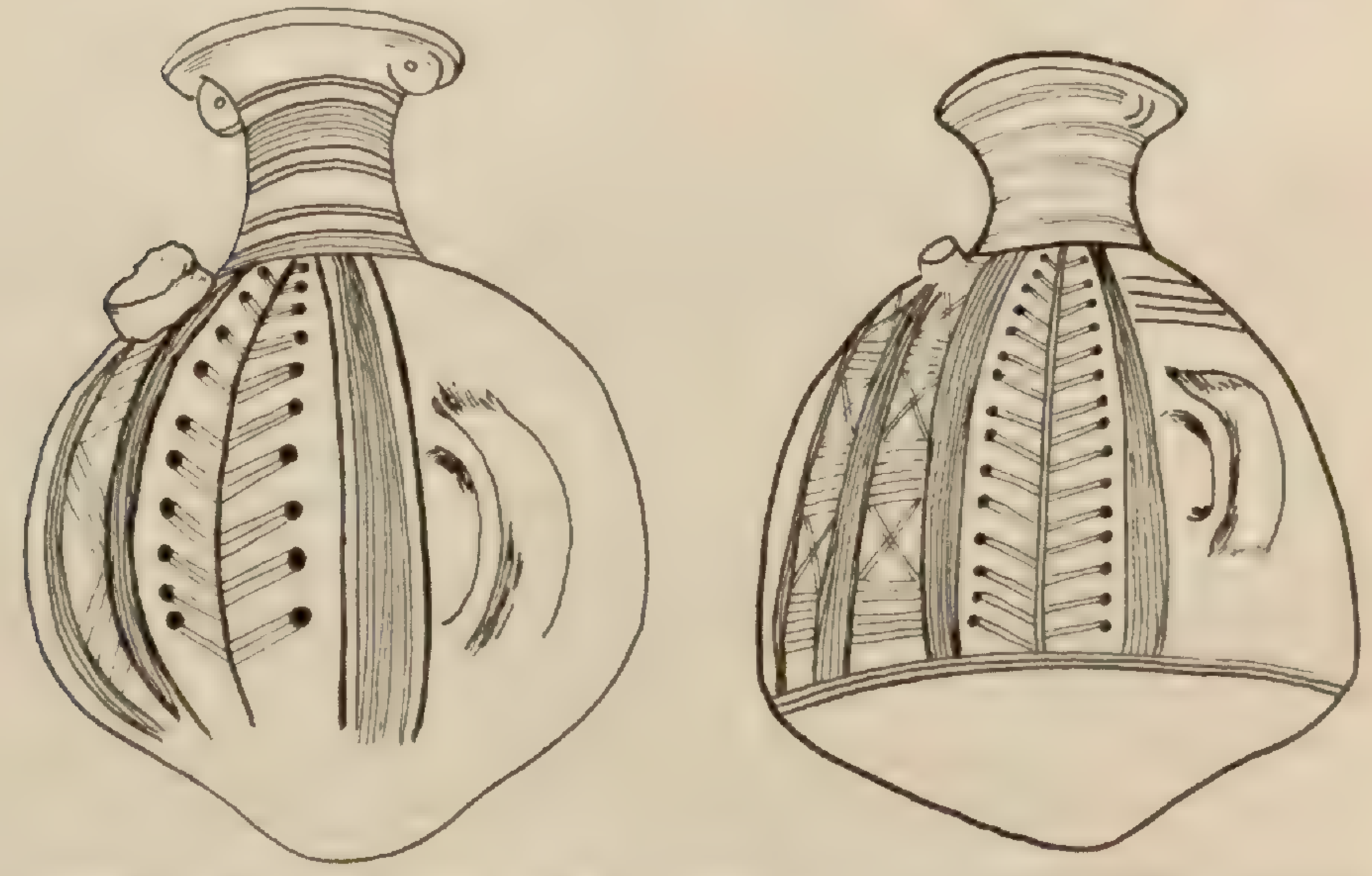
Quechua, the language of the Incas, which still predominates in the southern highlands, has been the source of a remarkable number of English words as pampa, a

treeless plain; puma, a cat-like creature; llama, vicuna, and guanaco, the cameloid animals of the Andes; coca, the drug plant, and jerk, from charqui, strips of dried meat. Many Spanish words, particularly of the New World, have also come from Quechua as papas, potatoes; palta, avocado; yuyo, weed, and chacra, a small farm. The Quechua language has given such plant names as *Cantua buxifolia* from Ccantu, *Stipa ichu* from I'chu, *Chenopodium quinoa* from Quiuna, *Peperomia ppucu-ppucu* from Ppucu-ppucu, *Calceolaria puru-puru* from Puru-puru, and *Gentiana conchalaguala* from Conchalaguala. The fern *Polypodium incopcam* from Incopcam is mentioned by Ruiz.

Studies of Quechua philology by Fortumato Herrera, his floristic work, and that already noted on the chroniclers convey his vibrant interest in the Peruvian aborigines. The Synopsis of the Flora of Cuzco, 1941, culminates his work on the plants of that area and lists the following ferns and their applications. *Cyathea cuspidata*, "Sano-sano," the stems and petioles secreting a mucilage which is employed in healing wounds; *Polypodium angustifolium* and *P. pycnocarpum*, "Calaguala," "Ccalahuala," used in medicine as an astringent and diaphoretic; *Dryopteris paleacea*, "R'aqui-r'aqui," the young frond tips eaten as salad; *Dennstaedtia Lambertiana*, "R'aqui-r'aqui," cultivated for decoration; *Asplenium monanthes*, "Kumu-kumu," used as a diaphoretic; *Cheilanthes ornatissima*, "Kumu-kumu," cultivated as an ornamental; *Notholaena nivea*, "Inca-sairi" or "Culandrillo de pozo," used as a sudorific and emmenagogue; *Cheilanthes incarum*, "Inca-ceca," "Kutukutu," the rhizomes and fronds used in an infusion for bronchitis, chronic hoarseness, and lung diseases; *Equisetum bogotense* and *E. giganteum*, "Mocco-mocco," "Cola de caballo," prepared in an infusion as a diuretic. The first of his papers on Quechua philology is an analysis

of plant names that are formed by the duplication of the same radical, like "Sano-sano"; it was motivated by the controversy as to whether such repetition implied that the plants were of medicinal value. In his analysis, these names are arranged in groups based on plant morphology—the stem, "Mocco-mocco," referring to the joints or knots of *Equisetum bogotense;* the leaves, "Kumu-kumu," *Cheilanthes myriophylla* or *Asplenium monanthes*, and "Kutu-kutu," *Cheilanthes incarum.* From this investigation he concludes that there is no certainty whether such reduplication denoted medicinal properties of the plants. Another paper organizes the Quechua plant names into categories based on their essential properties from which the following information is obtained. "Chipi-cuca," *Polypodium Buchtienii* and *P. subrestitum* means "False Coca," and "Anca-pfurum," *Polypodium crassifolium*, "Eagle-like bird feather," from the resemblance of the fronds to the feather of a bird. "Inca-cuca," *Cheilanthes incarum* is translated as "Coca of the noble people" and "Inca-sairi," *Notholaena nivea*, as "Tobacco of the noble people." The names are also arranged into bi, tri and tetrasyllabic groups, among which is the fern "Chirumpi," *Adiantopsis radiata*, cultivated as an ornamental, an example of the trisyllabic order. From these papers it appears that the Quechua name for fern is "R'aqui-r'aqui" and the following are called by this name: *Dennstaedtia Lambertiana, Dryopteris paleacea, D. subandina, D. glanduloso-lanosa, Polystichum Wolfii.* "Cuti-r'aqui-r'aqui," *Asplenium fragile* and "Nutu-r'aqui-r'aqui," *Cheilanthes pruinata*, mean "Small fern." The word "R'aqui" is also applied to the jug-like vessels or aryballos, varying in size from eight inches to three feet, used to store their corn beer, "Chicha," and which are often decorated with fern designs. The pattern is a common one found on ceramics belonging to the Late Inca period between 1438 and 1532.

I have seen the design on pottery or fragments from Pachacamac, Chicama, Chincha, and Machu-Picchu, and on cooking vessels and jugs as well as aryballos. Several drawings of ceramics ornamented with fern designs are illustrated in Hiram Bingham's work, "Machu-Picchu, a Citadel of the Incas," and one of the jugs is indicated as evidently the property of a wizard or medicine man



ARYBALLOS FROM THE LATE INCA PERIOD (1438–1532) CALLED "R'AQUI," DECORATED WITH STYLIZED FERN DESIGNS WHICH CAN PERHAPS REPRESENT POLYPODIUM. NOTE THE SETS OF PARALLEL LINES IN TWOS AND THREES. REDRAWN FROM HERRERA AND YACOVLEFF

from its contents of seeds, mosses, bone, and bits of charcoal. Two aryballos from the paper by Herrera and Yacovleff are redrawn here in reference to their comment that venation by two and three veins is clearly distinguished. A botanical interpretation of such highly stylized designs is difficult but it would seem more likely that the parallel lines represent the margins of the lobes of the leaf where they are in sets of two and where a third is shown a central vein is indicated. Whatever interpretation might be made the pattern is an interesting one, illustrating modifications or variations of a design.

Philip A. Means, one of this countries celebrated authorities on Peruvian archeology, evaluates the contemporary people in his volume "Ancient Civilizations of the Andes" as, "the race which created the oldest, the choicest, the rarest, and, for us the choicest artifacts from the ancient periods of the Andean area, is still living and, relatively speaking, is almost unchanged in custom, character and genius." This idea is confirmed by scholars and technicians who have journeyed to Peru to observe methods of weaving, of keeping of quipus (the knot records), of building, and of agriculture, or to record stories and music in order to interpret better the ancient cultures.

The markets of Peru are irresistible to most visitors, and for the botanist a certain place to gather records on plants. The ferns are no exception, for we saw them among the wares of herb vendors in Cuzco, Huancayo, and Lima. At the Lima market, I had the good company of Dr. Emma Cerrate of the University of San Marcos Herbarium at the Museo de Historia Natural, an able botanist and fluent in Quechua. We collected and made records on the following: *Equisetum bogotense* and *E. giganteum*, "pinco-pinco," prepared as a tea for diseases of the liver and kidneys; *Adiantum Capillus-veneris*, "Culantrillo," an infusion is used as an enemmagogue; *Asplenium triphyllum*, "Culantrillo," a tea taken to improve the blood; *Cheilanthes pruinata*, "Cuti-cuti," taken as a tea for diseases of the kidneys and diabetes; *Notholaena aurea*, "Cuti-cuti," prepared as tea for diabetes; and *N. nivea*, "Cuti-cuti-blanco," mixed with *C. pruinata* and brewed as a tea for diabetes. Samples from the Pisac market of the resin of *Cyathea cuspidata*, "Sano-sano," were obtained from Dr. César Vargas, the Peruvian authority on potatoes at the University of Cuzco; bamboo joints were used to store the resin, which is used on wounds and broken bones. A sample of

Asplenium foeniculaceum was sent to the Museo de Historia Natural for identification by the Officina de Huanta in Ayacucho; this is called "R'aqui" by the Indians of the Sierra de Viscatan and used for a substitute for coca.

There is no formal register of botanists who have come to Peru, but plant specimens in herbaria throughout the world document the visits of Joseph de Jussieu, of Ruiz, Pavón, and Dombey to Tarma in 1779, of Née, who reached the Guarimaya valley on the Malaspina Expedition, of Humboldt and Bonpland to the Marañon, of Pearce, who traveled to Huanaco in search of plants for English gardens, and of Raimondi and Weberbauer who came and stayed. They record the many expeditions sent out by the Field Museum of Natural History and that six sent out by the University of California Botanical Garden collected ferns as well as *Nicotiana*, and that Killip and Smith, on a Smithsonian Institution expedition, collected roots as well as the leaves of ferns.

The following observations were made on a visit to Peru from July to November, 1956, in connection with the preparation of a manual of the ferns of Peru by Rolla M. Tryon. My lot was to assist, and as numerous Peruvian wives do, I soon learned to carry at least half of the load. Our object was not to explore but to take complete samples of the ferns, and to observe their haunts, so that the collections already made can be more readily interpreted. Our first trip was northeast to Iquitos, Peru's Atlantic port some 2300 miles up the Amazon. There we found many kinds of *Polypodium* perched on tree limbs and noted that the reason specimens of *Trichomanes Hostmannianum* may look as if they have been bathed in mud is because they grow on the inundated forest floor.

Contrary to popular belief, low jungles are not teeming with ferns, animals, nor even snakes. On the cool, east slope of the Andes, in the vicinity of Tingo Maria, in central Peru we made our richest collections. In cloud-

Above: Blechnum glanduloSum on an interior wall of a dwelling at Machu-Picchu. Below: Pteridium aquilinum, bracken, in cultivated terraces at Machu-Picchu

drenched mountain passes we found small Hymenophyllums on wet, mossy, rocks and above them colonies of tall tree ferns, *Cyathea*. The area near Tingo is expanding agriculturally and there are large plantations of tea and coca. Here the greatest weed problem is Bracken, *Pteridium aquilinum* var. *arachnoideum*, which takes over entire hillsides after they are cleared for crops and is rampant after burning. Here we collected the tallest of the Horsetails, *Equisetum giganteum*. While we prepared specimens we were approached by a native woman in her colorful array of bright skirts and shawls. She asked for some of this plant called "Pinco-pinco" from which she prepared a tea for liver complaints. We wondered how she knew it was the liver that troubled her, but in Lima we learned from a physician that *Equisetum* is popular and effective as a diuretic.

The southern highlands are the most scenic part of Peru for here the Incas reigned and their walls of precisely fitted stones are festooned with ferns. Nearby the fortress of Sacsahuaman guarding the city of Cuzco above 11,000 feet, we found several species in xeric habitats. The leaves of *Cheilanthes incarum* were coiled and covered with tawny scales giving the impression of an Inca huaca or relic more than of a fern. Plants of *Pellaea ternifolia* were compact and the leaf margins strongly enrolled. The leaves of *Cheilanthes pruinata* were viscid and those of *Notholaena nivea* were undercoated with white wax. The most magnificent ruin, Machu-Picchu, found within the past 50 years, a hidden retreat in the mountain tops above the Urubamba River, was rich in ferns. Bracken covers many of the old agricultural terraces and poses the problem of why there is no mention of this conspicuous species as a culinary or medicinal plant of the Incas. *Woodsia monteridensis* grew from the projecting stones of the roof gables, and symmetrical niches in the interior walls of dwellings were brightened

Chroniclers, records to 1900	Herrera & Valdizan	Markets
Trembladera Equisetum bogotense, E. giganteum	**Trembladera, Cola de caballo, Mocco-mocco, Pinco-pinco** Equisetum bogotense, E. giganteum, E. xylochaetum	**Cola de caballo, Pinco-pinco** Equisetum bogotense, E. giganteum
Doradilla Notholaena nivea	**Doradilla** Notholaena Fraseri (probably N. aurea)	
Culantrillo de pozo Adiantum Poiretii	**Culantrillo de pozo** Adiantum Capillus-veneris, A. Orbignyanum, Notholaena nivea	**Culantrillo** Adiantum Capillus-veneris Asplenium triphyllum
Polipodio Polypodium angustifolium, P. crassifolium, P. pycnocarpum		
Escolopendria Asplenium		
Viñay-Huayna Lycopodium complanatum	**China-huiñal-huaina** Lycopodium clavatum	
Calaguala Polypodium serratum, P. lineare	**Calaguala, cealahuala, cealaihua** Polypodium angustifolium, P. pycnocarpum	
Cuca-cuca, Incopcam Polypodium incopcam		
Punta-punta, Lengua de ciervo Polypodium crassifolium		
Espineu Asplenium		
	Sano-sano Cyathea cuspidata, Alsophila	**Sano-sano** Cyathea cuspidata
	R'aqui-r'aqui Dennstaedtia Lambertiana, Dryopteris paleacea, D. subandina, D. glandulosolanosa, Polystichum Wolfii	**R'aqui** Asplenium foeniculaceum

Cuti-r'aqui-r'aqui
Asplenium fragile

Nutu-r'aqui-r'aqui
Cheilanthes pruinata

Anca-pfurum
Polypodium crassifolium

Chipi-cuca
Polypodium Buchtienii, P. subvestitum

Chirumpi
Adiantopsis radiata

Inca-sairi
Notholaena nivea

Kumu-kumu
Asplenium monanthes, Cheilanthes ornatissima, C. scariosa, C. myriophylla, Polypodium xantholepis

Kutu-kutu, Inca-cuca
Cheilanthes incarum

Qquella-qquella
Adiantum digitatum

Cuti-cuti
Cheilanthes pruinata, Notholaena aurea

Cuti-cuti-blanco
Notholaena nivea

by young, pink fronds of *Blechnum glandulosum*. We collected these as well as the following at Machu-Picchu: *Adiantum Poiretii, Asplenium auritum, A. monanthes, Cheilanthes marginata, C. Poeppigiana, Elaphoglossum spathulatum, Ophioglossum reticulatum, Pityrogramma tartarea, Polypodium Herzogii, P. moniliforme, Pteris muricata,* and *Equisetum bogotense.*

The cultivation of potatoes, corn, cotton, and coca, the crops of economic importance, are often conceded as a contribution of the Incas and the peoples upon which their empire was built. That there were other plants they knew and utilized, such as these ferns, which have not been adopted by our culture, we know from the reports of the chroniclers, from their Quechua names, their artifacts, and from contemporary Andean people.

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A Range Extension in Arctic Alaska for Botrychium lunaria[1]

JOHN E. CANTLON,[2] WARREN H. WAGNER,[3] AND WILLIAM T. GILLIS[2]

The moonwort, *Botrychium lunaria* (L.) Swartz, has a circumpolar distribution, including Alaska, Canada, the northern United States, Greenland, Iceland, Scandinavia, northern Europe, and Siberia. It is also represented in the southern hemisphere in New Zealand, Australia, Tasmania, and Argentina. The most northern latitudes reported for the species by Hultén (1941–50) and Porsild (1951) are 61° N in the Urals, 66° N in the Ob and Yenisei Rivers in eastern Russia, and about 66° N in central Alaska. Böcher (1957) reports it from 73° N in Greenland. The present report concerns a collection from north of the Brooks Range, somewhat over 69° north latitude in arctic Alaska.

The locality data for the specimens are: Valley of the Okpilak River, ca. 45 miles south-southwest of Barter Island and ca. 250 miles north of Fort Yukon, Alaska, lat. 69° 26′ N, long. 144° 01′ W (U.S.G.S. Topographic series, Mount Michelson quadrangle), elev. ca. 2000 feet, J. E. Cantlon and W. T. Gillis, Nos. 57-1885 and 57-2063, 7 August and 10 August, 1957. The specimens are deposited in the herbaria of Michigan State University, University of Michigan, and the U.S. National Museum. The collections and observations were made during a study of plant micro-distribution patterns supported by a grant

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from the Arctic Institute of North America and the Arctic Research Laboratory.

The question arose whether these specimens might belong to the closely similar *Botrychium minganense* Victorin, the relationships of which to *B. lunaria* were recently discussed by Wagner and Lord (1956). Both species have been collected at high latitudes in Alaska. However, such characters as the green (rather than yellow-green) color of the specimens, the relatively broad segments with descending basal margins, the coarse and angular penultimate segments, and others indicate that these specimens are *B. lunaria*. We examined spores with the intention of comparing their measurements with the different sizes characteristic of the two species, but there were so many irregularities in spore structure—perhaps due to irregular freezing conditions in development—that no dependable measurements could be made.

Since *Botrychium lunaria* may occur at other sites on the arctic slope of Alaska and adjoining Yukon, Canada, a detailed description of the habitat is presented as a guide to future collectors in these areas. The Okpilak valley is mantled with glacial till of several ages, the highest being found approximately 2000 feet above the current flood-plain. The entire region is underlain with continuous permafrost, and lies north of the treeline. However, there are small stands of *Populus tacamahaca* Mill. on river gravels in protected valleys, the nearest stand being in the Ignek Valley sixty miles to the west (Spetzman, 1951). There is no frost-free season, but the surface is usually about half-free of snow by mid-June and some plants remain green until about September 1.

The vegetation of the region is arctic tundra. The communities range from marshes in very poorly drained sites to wet or upland meadows on the poorly to imperfectly drained soils, with the exposed crests supporting upland meadows or sparsely vegetated barrens. The

marshes are of sedges and grasses, the wet meadows are of cottongrass tussocks, sedges, dwarf-shrubs, and mosses; the upland meadows are of dwarf shrubs, mosses, herbs and lichens; and the barrens are of herbs, dwarf-shrubs and lichens. Shrub vegetation with the dominants from one to four feet tall occurs where the mantle of snow is thick enough to provide the necessary winter protection yet melts off quickly in the summer and does not shorten excessively the already short growing season. The coarse-textured alluvial soils on the lowest terrace close to the river channel may support very small stands of *Salix alaxensis* Cov., feltleaf willow, some stems of which reach 15 feet in the area.

The soils in the area (Tedrow, Drew, and Alderfer, 1957; Tedrow and Cantlon, 1958) range from Hydrosols and Bog on the wet end to Meadow Tundra and Upland Tundra soils on the gently to steeply sloping surfaces, and with Arctic Brown soils and Lithosols on the very well drained crests. Solifluction and other frost action produce colluvial materials on some steep slopes that lack identifiable soil profiles.

The actual collection site was a short, steep, south-facing slope in glaciofluvial materials. The slope is an old cut-bank formed when the Okpilak River was cutting through a small moraine which, following Detterman (1953) and Kunkle (1958) is Echooka, synchronous with late Wisconsin. The colony of moonwort is about 100 yards east and approximately 20 feet above the present river. The surface soil is a sandy loam. The vegetation is an open shrub-grass type, the shrubs ranging from 1 to 3–5 feet tall. Shrub cover ranges from 20 to 60 per cent, averaging about 40 per cent. The major shrub species are *Salix glauca* L. ssp., *Potentilla fruticosa* L., *Betula nana* L. ssp. *exilis* (Sukatch.) Hult. and *Vaccinium uliginosum*. L. The lower vegetation is dominated by grasses, particularly *Festuca altaica* Trin.,

Bromus pumpellianus Scribn. var. *arcticus* (Shear) Porsild, *Poa* spp., and *Agropyron sericeum* Hitchc. Abundant herbs are *Carex* spp., *Potentilla nivea* L., *P. vahliana* Lehm., *Kobresia myosuroides* (Vill.) Fiori and Paol., *Gentiana propinqua* Richards., *Epilobium* spp., *Androsace chamaejasme* Host., *Bupleurum americanum* Coulter and Rose, and *Artemisia tilesii* Ledeb. Mosses and lichens contributed little cover and few species were present.

The individual plants of *Botrychium lunaria* occurred as scattered individuals (sometimes in pairs) among the grass in the central part of the willow-grass stand. The entire colony appears to be confined to an area not more than 30 feet up and down the slope and 100 feet along it. Down-slope from the colony the willows are taller (up to 4½ feet) and more dense, and the soil more moist; without question the snow is deeper and later in melting down-slope from the colony. Up-slope from the colony the shrub cover thins out and is much shorter (less than 1 foot), the soil is more stony and drier, and winter snow cover is doubtlessly shallower.

Approximately 30 specimens were seen, 12 of which were collected. Each one was deeply rooted (about 1½ inches to base of rootstock) among clumps of grass, mostly under willow shrubs. The soil in which they grew was always a very well-drained dark brown, fibrous, organic-mineral material. The lower horizons were not examined.

The colony in question is obviously younger than the age of the glacio-fluvial surface on which it is found. The deepness of the organic-mineral soil in which all of the plants were rooted suggests that the species would not be a pioneer on raw mineral soils, and could come in only after other vegetation had been long established. Since the only sites of this nature in the area are post-pleistocene, the arctic slope range may likewise be post-pleistocene. It may be of significance that the Okpilak valley

is one of the several routes through the Brooks Range taken by the caribou as they migrate from their winter range on the south to their summer range on the arctic slope. If the caribou are agents of transport, similar habitats along rivers connected with the other passes through the Brooks Range might be logical places to make careful searches for additional colonies of *Botrychium lunaria*.[1]

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[1] An additional smaller, but almost identical, colony was discovered by the senior author in 1958. It was approximately one-fourth mile north of the one described.

The Ferns and Fern-allies of Northern Neck, Virginia[1]

CLYDE F. REED

Northern Neck is the peninsula that lies to the south of the Potomac River and is bounded on the north by that river, on the south by the Rappahannock River, and on the east by the Chesapeake Bay. Five counties make up the peninsula: (from the northernmost to the southernmost) King George, Westmoreland, Richmond, Northumberland, and Lancaster. The peninsula is about 90 miles in length from the bend of the Potomac River southeastward to the Chesapeake Bay, and varies from 10 to 25 miles in width. Northern Neck is made of coastal soils only. There are some swampy areas and millponds inland and many marshy places along the coast, but for the most part the land is dry and woodsy. Some of the plants that reach their northern limit of distribution, west of the Chesapeake Bay, on this peninsula are *Asarum virginicum* (heart-leaf), *Oxydendron arboreum* (sourwood), and *Galax aphylla* (wandflower).

Massey[2] listed only 8 specimens, representing 8 different species from the five counties of Northern Neck, namely: *Dryopteris noveboracensis* (Lancaster), *Pteridium aquilinum* var. *latiusculum* (Northumberland), *Lorinseria areolata* (Northumberland), *Osmunda regalis* var. *spectabilis* (Northumberland), *Equisetum prealtum* (Westmoreland), *Lycopodium complanatum* var. *flabelliforme* (King George), *Lycopodium lucidulum* (Northumberland), and *Lycopodium obscurum* var. *dendroideum* (Northumberland).

While studying the flora and herpetology[3] of North-

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[1] Contributions to the Flora of Virginia, No. 1.

[2] The Ferns and Fern Allies of Virginia, Bull. Virginia Polytechnic Institute, **37**(7): 1–110. 1944.

[3] See Reed, Journ. Washington Acad. Sci. **47**(1): 21–23. 1957, for the Herpetofauna of Northern Neck.

ern Neck during the past twelve years, the author has collected 20 species and varieties of ferns and 5 species and varieties of fern-allies, with more than 75 county records, represented by more than 165 annotated specimens. Since the author's collections add considerably to the present known distribution of the ferns and fern-allies in Virginia, an annotated list of the specimens collected by the author along with the records published to date follows below.

BOTRYCHIACEAE

1. BOTRYCHIUM DISSECTUM var. OBLIQUUM (Muhl.) Fernald—Coarse-lobed Grape-fern. KING GEORGE Co.: Deep ravine, 2 mi. W. of Owens, Aug. 28, 1957, *Reed* 38356; low woods, just E. of Owens, Aug. 28, 1957, *Reed* 39342; along Machadoc Creek, S. of Dahlgren, Aug. 28, 1957, *Reed* 39363; low woods near Shiloh, Nov. 9, 1957, *Reed* 39471. WESTMORELAND Co.: Roadside bank, 2 mi. S. of Oak Grove, Nov. 9, 1957, *Reed* 39461. RICHMOND Co.: Woods, 2 mi. SE. of Fonswood, Rt. 624, Nov. 9, 1957, *Reed* 39451. LANCASTER Co.: Low woods, 1 mi. N. of Morattico, near Litwalton, May 27, 1956, *Reed* 37726. No specimens of typical *B. dissectum* have been found on this peninsula.

2. BOTRYCHIUM VIRGINIANUM (L.) Sw.–Rattlesnake Fern. KING GEORGE Co.: Deep ravine, 2 mi. W. of Owens, Aug. 28, 1957, *Reed* 39358. LANCASTER Co.: Wooded ravine, SE. of Lively, May 27, 1956, *Reed* 39117.

OSMUNDACEAE

3. OSMUNDA CINNAMOMEA L.–Cinnamon Fern. KING GEORGE Co.: Jersey at US 301, Aug. 15, 1957, *Reed* 39091; swamp near Dahlgren, Aug. 28, 1957, *Reed* 39372; low woods near Shiloh, Nov. 9, 1957, *Reed obs.* WESTMORELAND Co.: Woods along creek, 7 mi. W. of Callao, Rt. 202, June 9, 1956, *Reed* 38977; low woods just N. of Maple Grove, Aug. 10, 1955, *Reed* 36675; wet ditches near Nomini Grove, W. of Lyells, Aug. 28, 1957, *Reed* 39375. RICHMOND Co.: Low woods, ½ mi. SE. of Warsaw, April 22, 1946, *Reed* 4437; 1 mi. E. of Farnham, May 30, 1946, *Reed* 5082. NORTHUMBERLAND Co.: Swampy woods near Clarks Mills, 1 mi. N. of Heathsville, May 15, 1954, *Reed* 33264; near Remo, E. of Wicomico Church, May 27, 1956, *Reed* 39154. LANCASTER Co.: Woods 1 mi. N. of Morattico, near Litwalton, May 27, 1956, *Reed* 37738; woods between Nuttsville and Morattico, May 27, 1956, *Reed* 39106.

4. OSMUNDA REGALIS var. SPECTABILIS (Willd.) A. Gray–Royal Fern. KING GEORGE Co.: Jersey, near US. 301, Aug. 15, 1957, *Reed* 39089; wet woods 2 mi. W. of Dahlgren, near Owens, Aug. 28, 1957, *Reed* 39333; low woods near Shiloh, Nov. 9, 1957, *Reed obs.* WESTMORELAND Co.: Wet ditches near Nomini Grove, W. of Lyells, Aug. 28, 1957, *Reed* 39373. RICHMOND Co.: Low wet places, ½ mi. SE. of Warsaw, April 22, 1946, *Reed* 4439; 2 mi. N. of Warsaw, Aug. 28, 1957, *Reed* 39377. NORTHUMBERLAND Co.: Near Reedville, May 7, 1933, (UVa., cited in Massey, p. 77). LANCASTER Co.: Woods between Nuttsville and Morattico, May 27, 1956, *Reed* 39110.

PTERIDACEAE

5. DENNSTAEDTIA PUNCTILOBULA (Michx.) Moore–Hay-scented Fern. KING GEORGE Co.: Woods 2 mi. W. of Dahlgren, near Owens, Aug. 28, 1957, *Reed* 39331. WESTMORELAND-KING GEORGE Co.: Woods near pond, Rt. 206, just N. of Maple Grove, Aug. 10, 1955, *Reed* 36669. LANCASTER Co.: Woods 1 mi. N. of Morattico, near Litwalton, May 27, 1956, *Reed* 37739. WESTMORELAND Co.: Woods 2 mi. S. of Oak Grove, Nov. 9, 1957, *Reed* 39465.

6. PTERIDIUM AQUILINUM (L.) Kuhn var. LATIUSCULUM (Desv.) Underw.–Bracken or Eastern Brake. KING GEORGE Co.: Woods near Dahlgren, Aug. 28, 1957, *Reed* 39385. WESTMORELAND Co.: Roadside wastes, S. of Oak Grove, May 25, 1957, *Reed* 38860. RICHMOND Co.: Wet woods near Newlands, Aug. 28, 1957, *Reed* 39382. NORTHUMBERLAND Co.: Sandy wastes near Reedville, June 10, 1956, *Reed* 38974; wooded ravine 1 mi. S. of Wicomico Church, May 27, 1956, *Reed* 39139. "NORTHUMBERLAND Co'.," May 6, 1933 (UVa., cited in Massey, p. 70). LANCASTER Co.: Woods between Nuttsville and Morattico, May 27, 1956, *Reed* 39108; millpond N. of Kilmarnock, May 27, 1956, *Reed* 39128.

ASPIDIACEAE

7. ONOCLEA SENSIBILIS L.–Sensitive Fern. KING GEORGE Co.: Dogue, Aug. 15, 1957, *Reed* 39087; deep ravine, 2 mi. W. of Owens, Aug. 28, 1957, *Reed* 39357; woods just E. of Owens, Aug. 28, 1957, *Reed* 39344. WESTMORELAND Co.: Wet pinewoods, S. of Colonial Beach, May 25, 1957, *Reed* 38872; edge of pond, Rt. 205, just N. of Maple Grove, Aug. 10, 1955, *Reed* 36674. RICHMOND Co.: Low woods just N. of Warsaw, Nov. 9, 1957, *Reed obs.* NORTHUMBERLAND Co.: Woods near Remo, E. of Wicomico Church, May 27, 1956, *Reed* 39150. LANCASTER Co.: Woods between Nuttsville and Morattico, May 27, 1956, *Reed* 39112; millpond N. of Kilmarnock, May 27, 1956, *Reed* 39130.

8. ATHYRIUM FILIX-FEMINA (L.) Roth. (Including var. *asplenioides* (Michx.) Farw. and var. *Michauxii* (Spreng.) Farw.)–Eastern Lady Ferns. KING GEORGE CO.: Near Dogue, Aug. 15, 1957, *Reed* 39085; Jersey at US 301, Aug. 15, 1957, *Reed* 39337; woods just E. of Owens, Aug. 28, 1957, *Reed* 39343, 39348 (some forked pinnae); along Machadoc Creek, S. of Dahlgren, Aug. 28, 1957, *Reed* 39360; 4 mi. E. of Rt. 301 near Ninde, Aug. 28, 1957, *Reed* 39367. WESTMORELAND-KING GEORGE CO.: Woods, Rt. 205, just N. of Maple Grove, Aug. 10, 1955, *Reed* 36672, 36668. WESTMORELAND CO.: Low woods, 2 mi. S. of Hague, May 25, 1957, *Reed* 38850; just N. of Oak Grove, May 25, 1957, *Reed* 38855, 38845; near Leedstown, on Rappahannock River, Nov. 9, 1957, *Reed* 39458; 2 mi. S. of Oak Grove, Nov. 9, 1957, *Reed* 39464. NORTHUMBERLAND CO.: Near Clark Mill, 1 mi. N. of Heathsville, May 15, 1954, *Reed* 33256; woods along creek 7 mi. W. of Callao, Rt. 202, June 9, 1956, *Reed* 38976; 1 mi. NE. of Heathsville, June 1, 1946, *Reed* 5121; woods E. of Remo, E. of Wicomico Church, May 26, 1956, *Reed* 39145, 39147. RICHMOND CO.: Edge of wet woods, 2 mi. N. of Warsaw, Aug. 28, 1957, *Reed* 39378, 39379; woods near Newlands, Aug. 28, 1957, *Reed* 39383.

9. DRYOPTERIS SPINULOSA (Muell.) Watt.–Spinulose Wood Fern. KING GEORGE CO.: Jersey, Aug. 15, 1957, *Reed* 39090. WESTMORELAND CO.: Low woods, 2 mi. S. of Hague, May 25, 1957, *Reed* 38853.

10. DRYOPTERIS INTERMEDIA (Muhl.) A. Gray–Evergreen Wood Fern. KING GEORGE CO.: Jersey, at US 301, Aug. 15, 1957, *Reed* 39093.

11. DRYOPTERIS NOVEBORACENSIS (L.) A. Gray–New York Fern. KING GEORGE CO.: Jersey, at US 301, Aug. 15, 1957, *Reed* 39094; deep ravine, 2 mi. W. of Owens, Aug. 28, 1957, *Reed* 39354; woods, 2 mi. W. of Dahlgren, near Owens, Aug. 28, 1957, *Reed* 39330. WESTMORELAND-KING GEORGE CO.: Woods, Rt. 205, just N. of Maple Grove, Aug. 10, 1955, *Reed* 36673. WESTMORELAND CO.: Low woods, 2 mi. S. of Hague, May 25, 1957, *Reed* 38852. RICHMOND CO.: Along stream, SE. of Warsaw, May 29, 1946, *Reed* 4994. NORTHUMBERLAND CO.: Wooded ravine, 1 mi. NE. of Heathsville, June 1, 1946, *Reed* 5124; woods near Fairport, June 10, 1956, *Reed* 38956; near Remo, E. of Wicomico Church, May 27, 1956, *Reed* 39155. LANCASTER CO.: Along creek below Norris Pond, N. of Kilmarnock, Aug. 13, 1938, *A. B. Massey* 2143 (VPI-9701).

12. DRYOPTERIS SIMULATA Davenp.–Bog Fern. LANCASTER CO.: Low woods, 1 mi. N. of Morattico, near Litwalton, May 27, 1956, *Reed* 37729.

13. DRYOPTERIS THELYPTERIS (L.) A. Gray var. PUBESCENS (Lawson) A. R. Prince ex Weatherby.–Northern Marsh Fern. WESTMORELAND Co.: Swamp, Potomac Beach, May 15, 1954, *Reed* 33281. RICHMOND Co.: Wet woods, 2 mi. N. of Warsaw, Aug. 28, 1957, *Reed* 39376. NORTHUMBERLAND Co.: Damp shady woods near Clarks Mill, 1 mi. N. of Heathsville, May 15, 1954, *Reed* 33266, 33253; low woods near Heathsville, June 1, 1946, *Reed* 5138.

14. DRYOPTERIS HEXAGONOPTERA (Michx.) C. Chr.–Broad Beech Fern. KING GEORGE Co.: Deep ravine, 2 mi. W. of Owens, Aug. 28, 1957, *Reed* 39351. LANCASTER Co.: Wooded ravine, SE. of Lively, May 27, 1956, *Reed* 39118.

15. POLYSTICHUM ACROSTICHOIDES (Michx.) Schott.–Christmas Fern. KING GEORGE Co.: Near Dogue, Aug. 15, 1957, *Reed* 39084; Jersey, at US 301, Aug. 15, 1957, *Reed* 39095; deep ravine 2 mi. W. of Owens, Aug. 28, 1957, *Reed* 39355; woods 2 mi. W. of Dahlgren, near Owens, Aug. 28, 1957, *Reed* 39334; 4 mi. N. of Rt. 301, near Ninde, Aug. 28, 1957, *Reed* 39370; along Machadoc Creek, S. of Dahlgren, Aug. 28, 1957, *Reed* 39362. WESTMORELAND-KING GEORGE Co.: Woods, Rt. 205, just N. of Maple Grove, Aug. 10, 1955, *Reed* 36670. WESTMORELAND Co.: Woods near millpond, 1 mi. N. of Montross, May 25, 1957, *Reed* 38847; near Leedstown, on Rappahannock River, Nov. 9, 1957, *Reed* 39456. RICHMOND Co.: Woods 4 mi. E. of Warsaw, May 30, 1946, *Reed* 4960; 2 mi. SE. of Fonswood, Rt. 624, Nov. 9, 1957, *Reed* 39448, 39449, 39452. NORTHUMBERLAND Co.: Woods near Remo, E. of Wicomico Church, May 27, 1956, *Reed* 39151. LANCASTER Co.: 1 mi. N. of Morattico, near Litwalton, May 27, 1956, *Reed* 37730; woods between Nuttsville and Morattico, May 27, 1956, *Reed* 39111.

16. POLYSTICHUM ACROSTICHOIDES forma INCISUM (A. Gray) Gilbert.–Serrate Christmas Fern. KING GEORGE Co.: Along Machadoc Creek, S. of Dahlgren, Aug. 28, 1957, *Reed* 39364. WESTMORELAND Co.: Woods near Leedstown, on Rappahannock River, Nov. 9, 1957, *Reed* 39455.

ASPLENIACEAE

17. ASPLENIUM PLATYNEURON (L.) Oakes.–Ebony or Brownstem Spleenwort. KING GEORGE Co.: Jersey, at US 301, Aug. 15, 1957, *Reed* 39096; deep ravine, Rt. 206, 2 mi. W. of Owens, Aug. 28, 1957, *Reed* 39350; woods 2 mi. W. of Dahlgren, near Owens, Aug. 28, 1957, *Reed* 39335; 4 mi. E. of US 301, near Ninde, Aug. 28, 1957, *Reed* 39365; low woods near Shiloh, Nov. 9, 1957, *Reed* 39472. WESTMORELAND Co.: Woods just S. of Colonial Beach, May 25, 1957, *Reed* 38874; near Leedstown, on Rappahannock River, Nov.

9, 1957, *Reed* 39459. RICHMOND CO.: Foot of trees, 3 mi. SE. of Farnham, May 31, 1946, *Reed* 5021; woods NE. of Warsaw on road to Callao, May 30, 1946, *Reed* 4953; 2 mi. SE. of Fonswood, Rt. 624, Nov. 9, 1957, *Reed* 39450. NORTHUMBERLAND CO.: Roadsides, Coan River, S. of Lottsburg, May 29, 1954, *Reed* 33287; woods E. of Remo, E. of Wicomico Church, May 27, 1956, *Reed* 39148. LANCASTER CO.: Low woods, 1 mi. N. of Morattico, near Litwalton, May 27, 1956, *Reed* 37728; woods, Lively, May 31, 1946, *Reed* 5006-A.

18. ASPLENIUM PLATYNEURON var. INCISUM (Howe) Robinson.–Serrate Ebony Spleenwort. WESTMORELAND-KING GEORGE CO.: Woods, Rt. 206, just N. of Maple Grove, Aug. 10, 1955, *Reed* 36671. NORTHUMBERLAND CO.: Damp slopes, Heathsville, June 1, 1946, *Reed* 5142. LANCASTER CO.: Woods near Lively, May 31, 1946, *Reed* 5006.

BLECHNACEAE

19. WOODWARDIA VIRGINICA (L.) Sm.–Virginia Chain-fern. WESTMORELAND CO.: Wet pinewoods, just S. of Colonial Beach, May 25, 1957, *Reed* 38867.

20. LORINSERIA AREOLATA (L.) Presl.–Narrow-leaved Chain-fern. KING GEORGE CO.: Dogue, May 15, 1957, *Reed* 39086; Jersey, near US 301, Aug. 15, 1957, *Reed* 39088; woods 2 mi. W. of Dahlgren, near Owens, Aug. 27, 1957, *Reed* 39338; low woods near Shiloh, Nov. 9, 1957, *Reed* 39475. WESTMORELAND CO.: Wet ditches and pinewoods, just S. of Colonial Beach, May 25, 1957, *Reed* 38877; woods, 7 mi. W. of Callao, June 9, 1956, *Reed* 38979; just N. of Maple Grove, Aug. 10, 1955, *Reed* 36676; near Nomini Grove, W. of Lyells, Aug. 28, 1957, *Reed* 39374; near Leedstown, on Rappahannock River, Nov. 9, 1957, *Reed* 39457. RICHMOND CO.: Along streams, SE. of Warsaw, May 29, 1946, *Reed* 4999; pinewoods near Haynesville, May 29, 1954, *Reed* 33295. NORTHUMBERLAND CO.: Wet roadsides, ditches, Coan River, S. of Lottsburg, May 29, 1954, *Reed* 33288; swampy woods E. of Remo, E. of Wicomico Church, May 27, 1956, *Reed* 39153; in woods, without locality, May 6, 1933. (UVa., cited by Massey, p. 73); wet ditches, Heathsville, June 1, 1946, *Reed* 5139; swampy woods, Clarks Mill, 1 mi. N. of Heathsville, May 15, 1954, *Reed* 33265, 33254. LANCASTER CO.: 1 mi. E. of Lively, in damp woods near creek, Aug. 13, 1938, *A. B. Massey* 2144 (VPI-9635); woods 1 mi. N. of Morattico, near Litwalton, May 27, 1954, *Reed* 37740; woods between Nuttsville and Morattico, May 27, 1956, *Reed* 39107; millpond N. of Kilmarnock, May 27, 1956, *Reed* 39129.

LYCOPODIACEAE

21. LYCOPODIUM LUCIDULUM Michx.–Shining Clubmoss. NORTHUMBERLAND CO.: Near Highway 37, May 7, 1933 (UVa., cited in Massey, p. 91).

22. LYCOPODIUM OBSCURUM L.–Flat-branched Ground-pine. WESTMORELAND CO.: Woods, near Leedstown, on Rappahannock River, Nov. 9, 1957, *Reed* 39453; 3 mi. S. of Colonial Beach, Nov. 9, 1957, *Reed* 39467.

23. LYCOPODIUM OBSCURUM var. DENDROIDEUM (Michx.) D. C. Eaton.–Round-branched Ground-pine. NORTHUMBERLAND CO.: Along Highway 37, May 6, 1933 (UVa., cited in Massey, p. 92).

24. LYCOPODIUM COMPLANATUM L. var. FLABELLIFORME Fernald.–Running Pine or Trailing Evergreen. KING GEORGE CO.: No data, May 6, 1933 (UVa., cited by Massey, p. 89); woods, 4 mi. E. of Rt. 301, near Ninde, Aug. 28, 1957, *Reed* 39366; low woods near Shiloh, Nov. 9, 1957, *Reed* 39470. WESTMORELAND CO.: Woods just N. of Oak Grove, May 25, 1957, *Reed* 38846; woods near Leedstown, on Rappahannock River, Nov. 9, 1957, *Reed* 39454; 2 mi. S. of Oak Grove, Nov. 9, 1957, *Reed* 39462. RICHMOND CO.: NE. of Warsaw, on road to Callao, May 30, 1946, *Reed* 4943, 4950-A; woods 3 mi. SE. of Farnham, May 31, 1946, *Reed* 5019. NORTHUMBERLAND CO.; Wooded ravine, 1 mi. NE. of Heathsville, June 1, 1946, *Reed* 5126; near Remo, E. of Wicomico Church, May 27, 1956, *Reed* 39152.

EQUISETACEAE

25. EQUISETUM HYEMALE L. var. AFFINE (Engelm.) A. A. Eaton.–American Scouring-rush. WESTMORELAND CO.: Colonial Beach, Nov. 21, 1935, *A. N. Leeds* (Phila., cited in Massey, p. 86).

REED HERBARIUM, BALTIMORE, MD.

Recent Fern Literature

"FLOWER AND GARDEN MAGAZINE" is a new publication that can be recommended. It comes in two editions—the eastern and the Mid-America (for states from the Appalachians to the Rockies). The December, 1958, number for instance contains major articles on Longwood Gardens, on the house plant "Moses in the Bullrushes" (*Rhoeo discolor*), on Dutch elm disease and its control, on keeping Christmas plants, on new kinds of Amaryllis,

and a valuable section enumerating and commenting on many current catalogs of seed dealers and nurserymen, as well as numerous short features, including classified advertisements. Far western subscribers will find a good deal of interest also, even though their area is not specifically covered. Published monthly by Mid-America Publishing Corporation, 543 Westport Road, Kansas City 11, Missouri ($3.00 annually, no foreign subscriptions accepted).—C.V.M.

"SYNTHETIC AND WILD ASPLENIUM GRAVESII"[1] is a more technical article supplementing Mr. Darling's "In Search of the Rock-fern Hybrid Asplenium Gravesii."[2] Artificial crossing has proved by cytological study that *Gravesii* is the result of the cross *A. Bradleyi* × *pinnatifidum*. The evidence indicates moreover that these two species are themselves the results of former crossings, *A. Bradleyi* having arisen presumably from *A. montanum* × *platyneuron* and *A. pinnatifidum* from *A. montanum* × *rhizophyllum*. This paper concludes with a key that will be useful in distinguishing these plants, as well as *A. ebenoides*, *A. Trudellii*, and *A. kentuckiense*. The reviewer has a few extra copies available for distribution. —C. V. MORTON.

A book sent for review is "THE BOTANICAL LORE OF THE CALIFORNIA INDIANS," by John Bruno Romero.[3] It purports to be an account of Indian folklore, including legends and medicinal uses of Californian plants, but it is more entertaining if read as pure fiction rather than for information. It reads very strangely to one who, like myself, was reared in California and who received his botanical training there. The author, a full-blooded

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[1] By W. H. Wagner, Jr. and Thomas Darling, Jr. Brittonia 9: 57–63. 1957.

[2] This JOURNAL 47: 55–66. 1957.

[3] Pp. 1–82. Published by Vantage Press, Inc., 120 West 31st St., New York 1, N. Y. $2.50.

Indian, must have lived for some time in the eastern states or at least have been contaminated by reading too many eastern books. He reports that in the early days of California, before the arrival of the mission friars, the region east of Santa Barbara was covered by "a dense forest of the giant elm, *Ulmus pubescens*" and that these trees were hollowed out and shaped into boats that were used for trade with Santa Rosa Island; elm trees have never been known in California, except as cultivated trees in relatively recent times. The mountain laurel, *Kalmia latifolia,* is said to grow in the high mountains of California, and be greatly relished, and that "deer in large numbers look for this shrubby tree," as well they might since it doesn't grow any nearer to California than western Kentucky (and incidentally it might be just as well if they didn't find it, since it is known to be poisonous). The author urges the white man to conserve and not destroy that "really valuable plant" the pokeweed (*Phytolacca decandra*), "a common inhabitant of California's coastal region," a piece of gratuitous advice if there ever was one, since the pokeweed has never been found in California by a botanist. The author states that the roots of the poison oak, cut and dried, "when taken in the form of tea in a quantity of not more than four ounces, will render a person immune against any further poisoning," but considerately asks his readers in a footnote not to try this, pending further laboratory experiments! Perhaps an insurance against lawsuits?

As to the few ferns mentioned, the hay-scented-fern (*Dennstaedtia punctilobula*) is said to have its habitat "in the high California mountain ranges" [nearest locality to California known is Missouri]; it is said to bear "oil nodules on the crown of the root system," which are used for lung diseases. The purple cliff-brake (*Pellaea atropurpurea*, also not known from California by Mrs. Tryon, the monographer of *Pellaea*) is said to grow "abundantly on most of the limestone formations and

seldom found anywhere else''; ''like *Ephedra* it makes a delicious tea.'' He records that maidenhair fern was one of the ingredients of the ''herb steam baths'' that were used for curing ''black measles'' [smallpox?], but fails to mention a real use by the Californian Indians, as authenticated by specimens in the National Museum, of the dark, polished stems for weaving the ornamental designs in baskets. The bracken is said to be well known to every Indian for the part it played in making the bed of Allessandro and Ramona when they eloped. But enough said. *Caveat lector!*—C. V. MORTON.

C. A. NINAN. PAPERS ON THE CYTOLOGY OF SOME FERNS AND FERN ALLIES.—Since the publication of Dr. Manton's basic work on ''Problems of Cytology and Evolution in the Pteridophyta'' in 1950, the number of papers on the cytology and phylogeny of ferns and fern allies has considerably increased all over the world, and many questions regarding relationships and other problems have been solved in the last few years. C. A. Ninan (partly with Prof. A. Abraham), of the Botany Department, Travancore University, Trivandrum, India, has undertaken cytological studies of a number of native species, and has published the results in several small papers.

In 1958,[1] he proved that *Isoëtes coromandelina* L. f. shows intraspecific polyploidy, with a complete or partial failure of chromosome pairing at meiosis and with apogamous reproduction. Two clones are known within this species with $2n = 22 + 1$ and $2n = 33 + 1$. *Isoëtes Sampathkumarani* Rao shows $2n = 66$. It seems probable that 11 is the basic chromosome number in a large number of species of *Isoëtes* (*I. coromandelina*, *I. Sampathkumarani*, *I. echinospora* [= *I. tenella*], *I. asiatica*, *I. japonica*, and *I. lacustris*). This might also be considered as a proof of

[1] Studies on the Cytology and Phylogeny of the Pteridophytes. V. Observations on the Isoëtaceae. Journ. Indian Bot. Soc. 37[1]: [93]–103, *pl. 4–8*. 1958.

the existence of an ancestral type within the pteridophytes of a chromosome number as low as $n = 11$. [cf. et A. Abraham and C. A. Ninan].[2]

Intraspecific polyploidy has been proved by Ninan[3] in 1956 in *Psilotum nudum* (L.) Palisot de Beauvois. The diploid clone ($2n$ = ca. 100) reported by Manton (1950) from Ceylon has not been reported so far from India, where the tetraploid ($2n = 208$) seems to be widespread. It seems "that diploids are fast disappearing, the tetraploids taking their place." An aneuploid triploid clone with $2n = 159$ is reported from India also. The basic haploid number seems to be 52, which is possibly derived from lower numbers ($n = 26$ or even $n = 13$).

Within the genus *Lycopodium*, the chromosome numbers seem to be derived from different basic numbers, according to Ninan.[4] From his studies, it seems that the infrageneric groups of Walton and Alston (in Verdoorn, Manual of Pteridology, 1938), based principally on Herter's system, are the most natural of all the systems proposed by different authors. In different subgenera different basic chromosome numbers are found, but not enough species have been investigated and a splitting up of the genus Lycopodium, as proposed by Campbell (Evolution of Land Plants, 1939) and Rothmaler (in Fedde, Repert. Spec. Nov. **54**: 56–67. 1944) does not yet seem either desirable or natural. According to Ninan, $n = 136$ in *Lycopodium Hamiltonii* Spring, *L. vernicosum* Hooker & Greville, *L. squarrosum* Forster, *L. macrostachys* Spring, *L. Phlegmaria* L. and *L. setaceum* Hamilton, $n = 104$ in *L. cernuum* L., $n = 48$ in *L. Wightianum*

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[2] Cytology of Isoëtes. Current Sci. **27**: 60, 61. *fig. 1–4*. February, 1958.

[3] Cytology of Psilotum nudum (L.) Beauv. (P. triquetrum Sw.). La Cellule **57**[3]: [307]–318, *fig. 1–11*, *pl. 1–4*. 1956.

[4] Studies on the Cytology and Phylogeny of the Pteridophytes. II. Observations on the Genus Lycopodium. Proc. Natl. Inst. Sci. India 24B[2]: [54] 66, *pl. 5–7*. Reprint issued Apr. 28, 1958.

Wallich ex Hook. & Grev.; *Lycopodium lucidulum* Michx. has been proved to have irregular meiosis [$2n$ = ca. 405] and it is therefore probable that this species is of hybrid origin; vegetative propagation through "bulbils" seems to be connected with this fact, as it is in *L. Selago* L., as demonstrated by Manton (1950).

A study of the cytology of *Equisetum debile* Roxburgh[5] shows that this species has a normal meiosis and has the same chromosome number (i.e. $n = 108$) as other species of the genus.

The study of *Ophioglossum reticulatum* L. by Abraham and Ninan[6] is a further proof for the allo- or autopolyploidal nature of the genus *Ophioglossum*. Manton (1950) showed that n = over 500 in *O. vulgatum* from Manchester, England, and gave records of other plants from England and Guernsey where the chromosome number of *O. vulgatum* was $n = 256$ and of *O. lusitanicum* L. $n = 128$, respectively. Abraham and Ninan report $2n$ = more than 1260 in *O. reticulatum* L. In a more recent paper on the cytology of the Ophioglossaceae in general, Ninan[7] shows that within the genus *Botrychium* a polyploid series based on a haploid number of $n = 94$ occurs. The species of Ophioglossaceae seem to have a basic number of $n = 15$. For *O. costatum* R. Brown, a number $n = 120$ is reported, and for *O. lusitanicum* L. (from India) $n = 240$. Observations on *Helminthostachys zeylanica* (L.) Hooker showed a number $n = 94$. The somatic number for *Botrychium lanuginosum* Wallich ex Hook. & Grev. is shown to be $2n = 180$.

A basic chromosome number of $n = 13$ is very probable for the Marattiaceae, and for the ancient vascular

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[5] Cytology of Equisetum debile Roxb. Journ. Indian Bot. Soc. **34**[2]: 112–114, *pl. 4*. 1955.

[6] The Chromosomes of Ophioglossum reticulatum L. Current Sci. **23**: 213, 214, *fig. 1, 2*, July, 1954.

[7] Cytology of the Ophioglossaceae. Current Sci. **25**: 161, 162, *fig. 1, 2*, May, 1956.

pteridophytes in general, according to the study on Marattiaceae by Ninan.[8] *Marattia fraxinea* J. E. Smith shows exactly a multiple of the basic number, i.e. $n = 78$; the meiotic chromosome number in *Angiopteris evecta* (Forster) G. F. Hoffmann $n = 80$ seems to have been derived from this.

The study[9] of wild material from four localities in India proves that within the genus *Osmunda* the chromosome number is remarkably uniform—$n = 22$ for *Osmunda regalis* agrees exactly with the results from the work of Manton, who found the same number in garden material of *O. cinnamomea* L., *O. Claytoniana* L., *O. palustris* Schrader, and *O. gracilis* Link, and in wild material of *O. regalis* L. from England. Also, the reports for *O. regalis* and *O. cinnamomea* from the United States by Britton (Amer. Journ. Bot. **40**: 575–583. 1953) and those by Manton (in Holttum, Flora of Malaya, 1954) for *O. javanica* Blume from Malaya and Ceylon agree.

Ceratopteris thalictroides (L.) Brongniart is shown[10] to have a chromosome number of $n = 77$ ($2n = 154$). In spite of the relatively large number, the chromosomes are large in size, thus recalling the condition in *Psilotum* and *Angiopteris*. The author concludes that treating *Ceratopteris* as representing a distinct, monotypic family, as is done by Ralph C. Benedict, E. B. Copeland, and others, is the most natural and in accordance with the facts.

These contributions on the cytology and phylogeny of Indian pteridophytes are of great importance in filling gaps in our knowledge of the cyto-genetics of pteridophytes. We hope that the author will pursue his studies

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[8] Studies on the Cytology and Phylogeny of the Pteridophytes. I. Observations of the Marattiaceae. Journ. Indian Bot. Soc. 35[2]: 233–239. *fig. 1–4, pl. 9, 10.* 1956.

[9] Ibid. III. Observations on Osmunda regalis L. *Op. cit.* 35[3]: 248–251. *fig. 1, pl. 11.* 1956.

[10] Ibid. IV. Systematic Position of Ceratopteris thalictroides (L.) Brong. *Op. cit.* 252–256, *fig. 1, 2, pl. 12,* 1956.

further, and that he will be able to publish a general work on the chromosome numbers of Indian pteridophytes, in which his results would be collected in one publication.—HANS PETER FUCHS, *Smithsonian Institution, Washington, D. C.*

HYBRID SWARMS OF PTERIS. A recent article by Dr. Trevor G. Walker[1] is of major interest to students of the evolution and systematics of the ferns. During the past decade many important studies, especially the pioneering researches of Professor Irene Manton, have revealed that hybridization is a significant force in creating variation in the ferns as in other vascular plants. The hybrids of ferns however have up to now fallen into only three main classes: (1) *Sterile plants*, the chromosomes unable to pair properly and the *spores inviable;* (2) *Fertile plants*, with normal chromosome pairing and sexual reproduction, in which the chromosome complements have been multiplied—*allopolyploids;* and (3) *Fertile plants*, without normal sexual reproduction, that reproduce by a complex and peculiar *apogamous life-cycle.* No case, to my knowledge, has heretofore been reported of a fourth type of crosses in which true "hybrid swarms" occur, where two species interbreed and form fertile hybrid populations with normal life cycles and normal chromosome behavior without doubling of chromosome numbers. True hybrid swarms generally show complicated segregation in successive generations, combining the parental characteristics in different proportions. They are well known in flowering plants (e.g., *Apocynum*, *Quercus*, *Aesculus*, and many other genera) but have not previously been recorded among the ferns.

In Dr. Trevor Walker's paper, three species of the *Pteris quadriaurita* complex of ferns in Ceylon are

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[1] Walker, Trevor G. 1958. Hybridization in some species of Pteris L. Evolution 12 (no. 1): 82–92.

described cytotaxonomically—*P. quadriaurita s.s.*, *P. multiaurita* (both of these sexual diploids with normal life cycle), and *P. confusa* (an apogamous diploid). Hybrids of the first two with the third of these species produce apogamous triploids (i.e., the chromosomes number $3n = 87$ rather than $2n = 58$ like the parents). But the triploids reproduce true, since there is no sexual reproduction, and the gametophytes (which form sporophytes directly by vegetative proliferation) are like the parent hybrid genetically.

On the other hand, the first two species, *P. quadriaurita* and *P. multiaurita* cross with each other wherever the natural habitat has been disturbed by man, and form hybrids which are apparently nearly 100 per cent fertile diploids, the meiotic process being normal and the spores normal. These hybrids are capable of interbreeding among themselves (and presumably with their parents) to produce many degrees of intermediacy connecting the original parental species. The intergrades are nicely illustrated by silhouettes (*fig. 1*). Taxonomists had given a formal name to plants combining the parental characters in a certain way, but Walker shows that this "*P. otaria*" is not a valid species but is really only a particularly common member of a hybrid swarm. A specimen of *P. otaria* was self-fertilized experimentally and gave rise among the progeny to practically all the different types of intermediates between *P. quadriaurita* and *P. multiaurita*. As a final proof, Walker synthesized *P. otaria* by artificially hybridizing the putative parents. The first and second generations of the artificial cross fully confirmed the conclusions.—W. H. WAGNER, JR. *University of Michigan, Ann Arbor, Mich.*

The most recent of Dr. Pichi-Sermolli's papers[1] on

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[1] Adumbratio Florae Aethiopicae, 5. Parkeriaceae, Adiantaceae, Vittariaceae. Webbia: **12**: 645–704. 1957.

Aethiopian ferns discusses the species of *Ceratopteris*, *Adiantum*, and *Vittaria*. The species of most interest to students of New World ferns is that called *Adiantum thalictroides* Willd. This species, which is common in the mountains from Mexico to southern South America, as well as in Africa, has usually been called *A. Poiretii* Wikstr. Pichi-Sermolli's studies indicate that the true *Poiretii* is a species confined to the small island Tristan d'Acunha in the South Atlantic Ocean, and that the wide-spread species should be called *A. thalictroides*. The matter deserves further investigation, for the wide-spread species is extremely variable, and the characters pointed out by Pichi-Sermolli need verification in the light of the abundant American material. Dr. Pichi-Sermolli indicates that another wide-spread species *A. caudatum* L. can also be segregated into several races that can be considered specifically distinct.—C. V. MORTON.

Notes and News

AN ANSWER TO ONE OF DR. ALLISON'S QUERIES.—In the last number of the Journal for 1958, Dr. Allison asks if cutting green fronds for decorative purposes injures a fern or affects the next season's growth. The answer was probably given in the pages of the Fern Journal during the nineteen twenties. The question was rather carefully considered with respect to the eastern evergreen "fancy fern," as the florists call it, *Dryopteris intermedia*, which was and still is collected, with many thousands of leaves shipped to cold storage in appropriate centers. Because these leaves are collected in the fall, about September, when they are past maturity, because some care must be exercised in collecting, to get good,

salable leaves, and because wild populations do not appear to have been depleted, it was concluded that no real injury was being imposed on the species.

I believe the same conclusion may apply to the collection of the "western sword fern," the florists' name for *Polystichum munitum*, the supply of which probably comes from wild plants; but this point may be more accurately answered by someone familiar with the field occurrence of this species in the far west.

During the past summer, I learned a fact hitherto unknown to me from a friend connected with a lumber company with thousands of acres of woodland in Vermont and other states. The lumber company regularly receives several hundred dollars each year from a contractor, who then employs collectors on the "piece" basis for the actual gathering of the crop of fancy fern.—R. C. BENEDICT.

The American Fern Society was recently invited to join the AMERICAN HORTICULTURAL COUNCIL and our Council has decided to accept. The American Horticultural Council is a non-profit national organization of individuals and societies interested in the welfare and progress of horticulture in general. The Council holds annual meetings, gives awards and citation for meritorious contributions to horticulture, issues an annual Proceedings and a News Bulletin, represents American horticulture at international congresses, and issues and encourages special publications. The annual dues for organizations is $10.00; individuals are eligible for membership ($5.00 annually). The Secretary-Treasurer is Donald Wyman, Arnold Arboretum of Harvard University, Jamaica Plain 30, Mass.

The most valuable publication of the Council is "The Directory of American Horticulture for 1958," which has been well and carefully compiled by Albert J. Irving,

President of the American Horticultural Council, assisted by Donald Wyman, G. H. M. Lawrence, and Carol H. Woodward. It is available from Dr. Wyman ($1.50). It consists firstly of a list of horticultural organizations in the United States, with the current officers; the Fern Society is far from being alone as a society devoted to a special group of plants; almost all the popular plants have their own societies—the African violet, amaryllis, begonia, bromeliad, cactus, camellia, carnation, chrysanthemum, cymbidium, daffodil, dahlia, delphinium, epiphyllum, fuchsia, geranium, gesneria, gladiolus, gloxinia, gourd, hemerocallis, herbs, hibiscus, holly, iris, lily, orchid, penstemon, peony, poinsettia, primrose, rhododendron, rose, snapdragon, and tulip, and some of the more popular flowers have several societies. There are other societies devoted to various economic plants—pecans, blueberries, figs, and so forth. There is even a Weed Society of America (incorporated 1956), whose aim may be somewhat different from that of the other organizations mentioned—to grow bigger and better plants. Numerous garden clubs, state and local, also support the Horticultural Council. The Directory also includes a list of coming flower shows (now out of date; this section could well be omitted in future editions, for this is a matter of transitory interest, suitable to monthly bulletins). Another feature is the list of arboretums and botanical gardens, which give many suggestions for interesting places to visit, a list of "garden centers," a list of colleges, universities, and agricultural experiment stations offering courses in horticulture, and finally a list of publications in horticulture.—C.V.M.

American Fern Society

Report of the President for 1958

The American Fern Society made progress along several fronts in 1958. First, we made steady gains in membership, for although nearly thirty discontinued membership at the end of the year, for a variety of reasons, there was a net gain, for we had 764 members in good standing at the year's end, as compared with 709 last year. The continued loyal support given the Society and its officers by the individual members makes possible the publication of the Fern Journal, the conduct of the Annual Fern Foray, the activities surrounding the Spore Exchange, the maintenance of the Society's Herbarium and Library at the University of Michigan, and our participation in the annual meetings of the American Institute of Biological Sciences and the various organizations and societies affiliated with the Institute.

The relationship between the American Fern Society and the American Institute of Biological Sciences has been cordial since the earliest organization of the Institute, and our comparatively small society has been welcome at the summer meetings in spite of the fact that we felt we were unable to pay the annual fee required of those formally affiliated with the A.I.B.S. But it has seemed unfair for us to continue year after year to enjoy the help extended us in getting our program included in the Bulletin and in having our one-day meeting correlated with the many others held in conjunction with the annual meetings of the A.I.B.S. without contributing a modest sum toward the cost of the undertaking. Accordingly, the Council met during the sessions at Bloomington, Indiana, in August, 1958, and voted to become affiliated with the A.I.B.S. provided the membership of the Fern Society should vote in favor of increasing our annual dues from $2.00 to $2.50, thereby making funds available to pay our affiliation fee to the A.I.B.S. Fol-

lowing this decision a proposal to increase the dues was placed on the ballot circulated in the autumn, together with an explanation as to why the recommendation for the increase was being made. The returns were very gratifying to the Council, for only eleven out of 328 votes cast opposed the nominal increase. As a result, the American Fern Society can become a full fledged affiliated society with the A.I.B.S., and have some additional money to devote to the publication of the Fern Journal. The increase in support for the Fern Journal is most welcome, for printer's costs have advanced steadily during the past few years, and we have been notified of an additional increase.

The President takes this opportunity to extend his personal appreciation to our past Secretary, Dr. Mildred E. Faust, for her services to the Society during the last five years. The weight of her duties increased considerably during her term of office, for the growth of the Fern Society made new and greater demands on her time and energy. I am sure that all members join with me in wishing her well and in thanking her for her efforts.

The Treasurer has faced heavy tasks during the year, also, for the article published in "Sunset" in 1957 i still stimulating an occasional reader of its pages to apply for membership in the Fern Society. Each new application for membership means work for the Treasurer, for he must forward to the publisher of the Fern Journal the name and address of each new member. There have been many changes in addresses among the members during 1958, and each change requires correspondence between Dr. Phillips and the publishers. Sincere thanks are passed along to him for his zeal and careful attention to many puzzling details during the first year in office.

Our Editor-in-Chief deserves the strongest praise of the whole Fern Society family, for on his shoulders falls the burden of regularly getting out the issues of the Fern Journal. He has carried through his duties in this field

willingly and cheerfully and has given generously of his time to other aspects of the Society's affairs. Not least among these is the task of mailing back numbers to subscribers who wish to fill a gap in a run of the Journal or of individual copies to enquiring prospective members. One can partially realize the magnitude of this task when one realizes that Mr. Morton has mailed out almost 900 copies of the Fern Journal during the year of 1958. Of course, we appreciate most the carefully prepared articles he writes for publication in the Fern Journal. As Editor-in-Chief, mailing clerk, and author, he deserves much credit and high praise.

It is a pleasure to commend all other members holding special posts and carrying out special tasks in the interest of the Fern Society. Dr. A. C. Smith, for serving as our Representative on the Council of the A.A.A.S.; Dr. Warren H. Wagner, Jr., for serving as Librarian and Curator of the Fern Herbarium; Dr. R. C. Benedict for continuing to serve on the Board of Editors; Mrs. Kathryn Boydston, for efficiently and enthusiastically running the Spore Exchange; and Mr. James E. Benedict, Jr., the Vice-President, who has supported the program of the Society and has given valuable advice from time to time: each of these deserves thanks and I am confident that all members of the society join with me in expressing a few words of praise for their efforts and devotion.

A hasty examination of the membership rolls of the Society reveals that there are forty-eight who have been in the American Fern Society for thirty years or more. Exactly half of that group is made up of those who joined the Society prior to 1920! Certainly an interest in ferns has been an enduring and satisfying one for so many to have held it unimpaired through such a long period. Particularly warm congratulations are hereby extended to all of these people, and it is a source of genuine regret that the press of duties makes a personal note to each of them impracticable. May each of you enjoy many more

years of happy association with kindred spirits who love ferns.

Nevertheless, may I send greetings to all other members of the American Fern Society, who, like me, joined its ranks since 1930. May 1959 bring you the satisfaction of seeing your ferns grow well, the Fern Journal contain at least a few articles that you enjoy, and may you make new friendships and renew old ones among the ranks of the Society.

Respectfully submitted,
IRA L. WIGGINS, *President.*

Report of the Secretary for 1958

The membership of the Fern Society continues to increase at an astonishing rate; we now have 764 members, as compared with 709 as of last year; California remains far in the lead with 152 members. Miss Elmira Noyes is the only charter member remaining in this 65th year of the Society. We regret to report the deaths of Dr. Frederick L. Fagley (1932) and Mrs. Stanley D. Simon (1951). A biography of Dr. Fagley will appear in a future number.

The annual summer field-trip, held in southern Ohio, was well attended; it is being reported on elsewhere in the Journal.

The annual meeting of the Society was held with the A.I.B.S. on the campus of Indiana University, Bloomington, Indiana, August 25, 1958. The meeting was well attended, between 40 and 50 persons being present. The morning session was presided over by our President, Ira L. Wiggins; the following papers, most of them illustrated, were presented: "Anomalous *Equisetum* strobili and the morphological interpretation of so-called 'sporangiophores'," by Richard L. Hauke; "Chromosomes in the North American members of the *Lycopodium complanatum* complex," by Joan H. Wilce (read by John Mickel); "Viability of *Osmunda* spores," by Herbert M.

Clarke; "The gametophytes of *Polypodium pectinatum* and *P. plumula*," by Alma G. Stokey (read by John Mickel); "The role of polyploidy in speciation of bladder-ferns (*Cystopteris*)," by Robert F. Blasdell; and "Some relationships within the genus *Woodsia*," by Donald F. M. Brown.

The luncheon at 12:30, presided over by Dr. Wiggins, was attended by 35 members.

The afternoon session, presided over by Mildred E. Faust, consisted of the following papers: "Some interesting fern records from Craters of the Moon, Idaho," by William H. Baker (read by title only, in the unavoidable absence of Professor Baker); "Collecting ferns by safari," by David F. Grether; "The ferns of a desert island," by Ira L. Wiggins; "The use of cleared fern leaves as lantern slides," by Rolla M. Tryon, Jr.; "Rare pteridophytes of Iowa," by Tom Cooperrider; and "Fern collecting in Thailand," by Marcel Raymond. Prof. Charles B. Heiser was of great assistance to the Society in being our local representative; the arrangements for the meeting and luncheon were capably handled.

The Council of the Society held a meeting at Bloomington, at which time a number of matters were discussed. It was decided to dispense with an annual meeting in the summer of 1959, as the Botanical Society is doing, because most botanists will wish to attend the Ninth International Botanical Congress which is to be held in Montreal, August 19–29.

It is with a deep sense of sadness that I retire from the secretaryship, which has been a privilege. It has been a rewarding five years of association with such cooperative and stimulating Councils and members. The Society is to be commended on its excellent choice of a new secretary, Dr. Donald G. Huttleston, of Longwood Gardens, Kennett Square, Pennsylvania.

Respectfully submitted,

MILDRED E. FAUST, *Secretary*

Report of the Treasurer for 1958

Receipts

	Amount	*Total*
Cash on hand, January 1, 1958		$1,678.82
1957 Membership Arrears	$ 35.70	
1958 Membership Renewals	811.95	
1959 Membership Advances	37.50	
1958 Sustaining Members	600.00	
1958 New Members	237.95	
1957 Subscription Arrears	25.95	
1958 Subscription Renewals	127.65	
1959 Subscription Renewals	189.50	
1960 Subscription Renewals	3.00	
Miscellaneous Receipts	4.56	
Sale of Back Numbers	348.82	
Sale of Reprints	206.61	
Advertising	40.00	
Gifts	3,066.00	
Overpayment by Book Agent	1.35	
		5,736.54
		$7,415.36

Disbursements

A. F. J. Vol. 47, No. 4	538.86	
A. F. J. Vol. 48, No. 1	824.09	
A. F. J. Vol. 48, No. 2	402.13	
A. F. J. Vol. 48, No. 3	404.52	
Reprinting Vol. 47, Nos. 1 and 3 and covers	250.53	
Reprints	171.81	
Envelopes and Mailing	94.10	
Membership Lists	90.24	
Delegate to AIBS	40.00	
Overpayment by Book Agent	1.35	
Expenses:		
President	40.00	
Secretary	42.73	
Treasurer	113.88	
		3,014.24
Transferred to Greenpoint Savings Bank (Una Weatherby Fund)		3,000.00
Cash in Southern Arizona Bank, Jan. 1, 1959		1,401.12
		$7,415.36

STATEMENT DECEMBER 31, 1958

Assets

Cash in Southern Arizona Bank, Jan. 1, 1959		$ 1,401.12
Cash in Greenpoint Savings Bank (Bissell Herbarium Fund)		675.12
Cash in Greenpoint Savings Bank (Life Membership Fund)		775.15
Cash in Greenpoint Savings Bank (Reserve Fund)		1,848.10
Cash in Greenpoint Savings Bank (Una Weatherby Fund)		3,024.37
Inventory, American Fern Journal		3,123.48
American Fern Society Library		396.00
		$11,243.34

Liabilities

Advance Dues Collected	230.00	
Accounts Payable (Vol. 48, No. 4)	612.78	
		842.78

Fund Balances

Bissell Herbarium Fund	675.12
Life Membership Fund	775.15
Reserve Fund	1,848.10
Una Weatherby Fund	3,024.37
General Fund	4,077.82
	$11,243.34

Respectfully submitted,
WALTER S. PHILLIPS, *Treasurer*

Report of the Auditing Committee

We hereby certify that we have seen the books and accounts of Dr. Walter S. Phillips, Treasurer of the American Fern Society, Inc., and have obtained confirmation of the correctness of the Society's balances on hand as set forth in detail in the accompanying report of the Treasurer.

Auditing Committee
HOWARD TENCH
RENA ALLEN

Report of the Judge of Elections

The results of the balloting for officers of the American Fern Society are as follows:

For President

Ira L. Wiggins	326
Rolla M. Tryon	3
Clair Brown	2

For Vice-President

James E. Benedict, Jr.	327
Marcel Raymond	1
Mrs. Charlotte Learned	1

For Secretary

Donald G. Huttleston	328
Kenneth A. Wilson	1

For Treasurer

Walter S. Phillips	328

I therefore declare the following candidates elected to the several offices: President, Ira L. Wiggins; Vice-President, James E. Benedict, Jr.; Secretary, Donald G. Huttleston; Treasurer, Walter S. Phillips.

The three amendments to Article III of the Constitution, raising the dues for membership from $2.00 to $2.50, were voted on as follows:

Amendment to Art. III, Sect. 2

Yes	315
No	11

Amendment to Art. III, Sect. 3

Yes	314
No	11

Amendment to Art. III, Sect. 4

Yes	315
No	11

I therefore declare these amendments to the Constitution passed and now in force.

Respectfully submitted,

LYMAN BENSON, *Judge of Elections*

Report on the 1958 Field-Trip

Officially, the 1958 Foray began at 8 a.m. on August 21st, but actual travel had commenced for most of its participants at least a full day earlier, for those meeting in Circleville, Ohio, had come from as far away as Michigan, Illinois, New Jersey, Connecticut, New York, Washington, D. C., and California. The travel prior to the official start of the Foray had, however, been only a means to an end. With its departure from the corner of Court and Main Streets, in Circleville, the group eagerly looked forward to seeing the native ferns of central and southern Ohio. Each member of the party was given a mimeographed set of directions on how to reach the scheduled stops and a list of the ferns known to occur at the various sites. The pre-Foray scouting by Richard Hauke and his two assistants, Robert Blasdell and John Mickel, had been done thoroughly and carefully. Mr. Floyd Bartley, who lives a few miles south of Circleville and who knows the flora of Ohio in great detail, had been of inestimable help in planning the trip; he added much to our enjoyment of the field experiences and was a source of much information about local habitats.

Our first stop was not on the schedule, for Mr. Bartley knew of a pond a couple of miles south of Lancaster where *Marsilea quadrifolia* grows in abundance, and had obtained permission for the Fern Society members to visit it. Although there were other ferns on the hillside above the pond, the *Marsilea* claimed our attention almost to the exclusion of anything else, so we listed only the attractive water fern and *Polystichum acrostichoides* at that stop. It was distinctly worth making the slight detour required and two or three judiciously small collections were taken.

Our second stop on the first day of the Foray was near an old sandstone quarry, now well covered with forest, where we found ferns in profusion. *Adiantum pedatum*, *Athyrium Filix-femina*, *Asplenium platyneuron*, *Denn-*

staedtia punctilobula, Dryopteris intermedia, Polystichum acrostichoides, and *Thelypteris hexagonoptera* occurred in comparative abundance in deep soil on the lower slopes of the shady hillside. *Woodsia obtusa* was found in several spots, each colony consisting of only a few plants. Scattered plants of *Botrychium obliquum* posed problems in lighting for the photographers. *Camptosorus rhizophyllus* and *Asplenium pinnatifidum* grew on some of the sandstone rocks and sides of the quarry, but neither species was abundant at this station. Other ferns seen here were *Athyrium Filix-femina* var. *rubellum, Dryopteris marginalis, Dryopteris spinulosa, Onoclea sensibilis, Osmunda Claytoniana,* and *Polypodium virginianum.* It was a delightful hillside, and some would have welcomed a longer stay so the many nooks and crannies of the old quarry might have been explored more thoroughly. Interesting flowering plants were much in evidence, too, and Dr. Buker found several plants of ginseng, which were photographed but not removed.

Three more stops were made before lunch, one to give us a chance to see *Polypodium polypodioides* crowning a large rock beside the road and numerous plants of *Woodsia obtusa* on the heavily shaded hillside; another to see beautiful stands of *Matteuccia Struthiopteris* and an attractive mat of a small saxifrage, *Chrysosplenium americanum,* carpeting a roadside ditch. As we drove on toward the fourth and fifth stops of the day, tremendous quantities of *Equisetum hyemale* were in evidence along stream banks for a distance of several miles, and near an attractive old covered bridge we were shown a puzzling assemblage of *Cystopteris fragilis* var. *Mackayi* and another *Cystopteris* bearing a few bulblets and which might be a hybrid between *C. bulbifera* and *C. fragilis* var. *Mackayi. Lycopodium porophilum* was intermingled with some of the *Cystopteris* plants and on steep banks at the "Covered Bridge stop."

The gravel road leading past Mr. Paxton's farm, where

we were to eat our lunches, was very dusty. Result:—the two leading cars turned into the lane at the Paxton farm, the third continued straight ahead in the cloud of dust! The driver soon discovered the error and returned, for the luncheon materials were in another car already parked in the Paxton lane.

After lunch, we followed the valley back a half mile or so, climbed a low ridge, and on the outcropping sandstone found *Asplenium montanum*, *A. pinnatifidum*, and *A. Trudellii* growing within 18 inches of one another. *Dennstaedtia punctilobula*, *Polypodium virginianum*, *Polystichum acrostichoides*, and *Thelypteris noveboracensis* were all present on the hillside, and Mr. Blasdell showed us another *Cystopteris* whose taxonomic status is still uncertain.

Our next stop was less than a mile farther east along the Pine Creek Road, at Mr. Harper's farm. There a short walk up an old road to a gas well and around the hill under beautiful oaks, maples and elms took us to sandstone outcrops where *Adiantum pedatum*, *Asplenium Trichomanes* and *Lycopodium porophilum* were present but scarcely abundant. As though he knew the exact locality of every fern in the state, Mr. Bartley lead us to several shallow pockets in the vertical sandstone outcrops, and in two or three of these that had trickles of water oozing down their walls grew beautifully delicate plants of *Trichomanes Boschianum*. This one species alone was worth the trip of the entire day.

The final stop on our first day in the field was in Cedar Fall State Park, where, in addition to a number of species seen earlier in the day we examined grand specimens of *Thelypteris Phegopteris*, admired huge boulders nearly smothered by *Camptosorus rhizophyllus* and *Polypodium virginianum*, and found numerous plants of *Lycopodium complanatum* var. *flabelliforme* and of *Lycopodium obscurum*.

Friday morning we drove farther south before making a stop, the first one being at the Allen Chapel Community Church, on a ridge overlooking a beautiful valley partly under cultivation and partly wooded. A short walk down the side of the ridge under the guidance of Mr. Bartley and Mr. Blasdell took us to a series of low sandstone cliffs. Through the woods and on top of the cliffs grew *Polypodium virginianum* and *Asplenium platyneuron*. In crevices and under overhanging parts of the cliff were *Asplenium Bradleyi, A. pinnatifidum,* and *A. montanum,* while *Dryopteris marginalis* and *Dennstaedtia punctilobula* grew abundantly on the wooded slopes below the main outcrops.

A mile and a half farther along the same gravel road we reached a ridge overlooking a huge gravel pit and on the hillside a few hundred yards from the road were several moist, well shaded caves where the prothallia of an undetermined *Hymenophyllum* grows year after year without, as far as anyone knows, ever producing sporophytes. Probably as many have done before, members of the Foray searched carefully in the cool caves for a single young sporophytic plant, but found none. Perhaps some brilliant stroke of genius will yet find a way to keep these tiny gametophytes growing in a greenhouse and apply the correct stimulus to produce the spore-bearing generation. If so, we may then learn the identity of this anomalous, perennially persisting colony of gametophytes. Among the other ferns in the immediate vicinity of the *Hymenophyllum* caves were *Asplenium pinnatifidum, A. montanum, A. Trichomanes,* and *A. Trudellii* on the rocks, *Dennstaedtia punctilobula* and *Dryopteris marginalis* in the soil in partial shade, and *Pteridium latiusculum* occupied the disturbed soil in full sun along the shoulders of the road.

After a delightful lunch stop in a roadside park, we drove to a densely wooded area near the New Hill Ceme-

tery, on the Thurman Road, where a magnificent carpet of *Lygodium palmatum* covered the ground and scrambled into the shrubs and up trunks of trees almost to shoulder level. Its pale green fronds were so attractive that few of us paid much attention to other ferns in the area, among which were *Botrychium obliquum, Osmunda Claytoniana* and *Woodwardia areolata.* No sporulating fronds of the latter could be found.

Our last stop on August 22nd provided a fitting climax to a wonderful day in the field. It was in a small canyon about two miles north of Jackson near an abandoned coal tipple. There we listed twenty-six species and varieties of ferns and fern allies, including *Botrychium dissectum, B. virginanum* and *Selaginella apus.* Walking ferns nearly smothered some of the boulders and magnificent specimens of *Asplenium platyneuron* dotted the hillsides.

The third day of the Foray was to an entirely different type of environment, for whereas we had confined our attention to sandstone areas during the first two days, the gorge of the Little Miami River, at and near Clifton, Ohio, is cut through limestone. The group assembled in front of the old mill on the outskirts of Clifton and Mr. Vannorsdall gave us a brief talk on the geology of the area before leading us along the south side of the stream over private land. We walked downstream to a footbridge, having descended from the brink of the gorge to a lower level about half way between Clifton and the State Park. Eleven ferns were seen during the walk, with *Cystopteris bulbifera* the most abundant and covering large areas on the steep banks and in deeply shaded woods. *Asplenium platyneuron* was well represented, as was *Camptosorus rhizophyllus* and *Polypodium virginianum.* A few plants of *Botrychium virginianum* were seen in denser parts of the woods, and on limestone boulders and ledges were *Pellaea atropurpurea, Asplenium Trichomanes, A. Ruta-muraria* and its endemic va-

riety, *ohionis*. Several healthy colonies of this rare fern were pointed out by Mr. Vannorsdall and lavish use of photographic film marked our examination of both varieties of *A. Ruta-muraria*. *Pellaea glabella* occurred in crevices and pockets in the limestone cliffs. Some of the plants were easily accessible, others were totally out of reach and apparently run little danger of molestation.

Beside one limestone slab Miss Clara Hires found a peculiar little fern that may have been an aberrant form of *Cystopteris bulbifera*, but the fronds were completely devoid of sporangia, so its identity remains uncertain.

Our final examination of native Ohio ferns occurred near the brink of the gorge on the north side of the river near Clifton, where we admired excellent growths of *Pellaea glabella*, much of it below the rim and completely out of reach. Many of us will remember the attractive smooth cliff brake as we saw it there for a long time.

The following members and guests took part in the 1958 Foray, most of them going on all three days of the trip, a few participating only a part of the time owing to pressure of business:

Kathleen Armstrong, Floyd Bartley, Dr. & Mrs. R. H. Benedict, Robert F. Blasdell, William W. Bloom, Mr. & Mrs. Walter Boydston, Muriel P. Brown, Florence Branum, Mr. & Mrs. W. E. Buker, Gladys Clarke, Andre F. Clewell, Mildred E. Faust, Mr. & Mrs. Robert Halbeisen, Richard T. Hanke, Mr. & Mrs. Edward G. Heinzelman, Dr. & Mrs. L. K. Henry, Clara S. Hires, Kenneth Hunt, Mr. & Mrs. Arthur R. Lord, John T. Mickel, Conrad V. Morton, Orra Phelps, Marian B. Rhodes, Eugene G. Rhodes, Eva Sobol, Harry H. Vannorsdall, Frieda L. Wertman, and Ira L. Wiggins.

Although the Foray concluded when we returned to the Old Mill, I am sure that each member and guest who participated in the three days of fern seeking will long remember the delightful hours spent under the able lead-

ership of the three young men, the information made so freely and charmingly available by Mr. Bartley, Mr. Vannorsdall's care in previously spotting exact localities in the gorge of the Little Miami River, and the very generous aid extended by Mr. Ed Heinzelman in furnishing transportation for those who came by train or plane. Each of them contributed whole-heartedly to the enjoyment of the out-of-state visitors. On behalf of all members of the American Fern Society who included the Foray in their summer activities, I extend to these generous people a cordial "Thank you!"—IRA L. WIGGINS. *Stanford University.*

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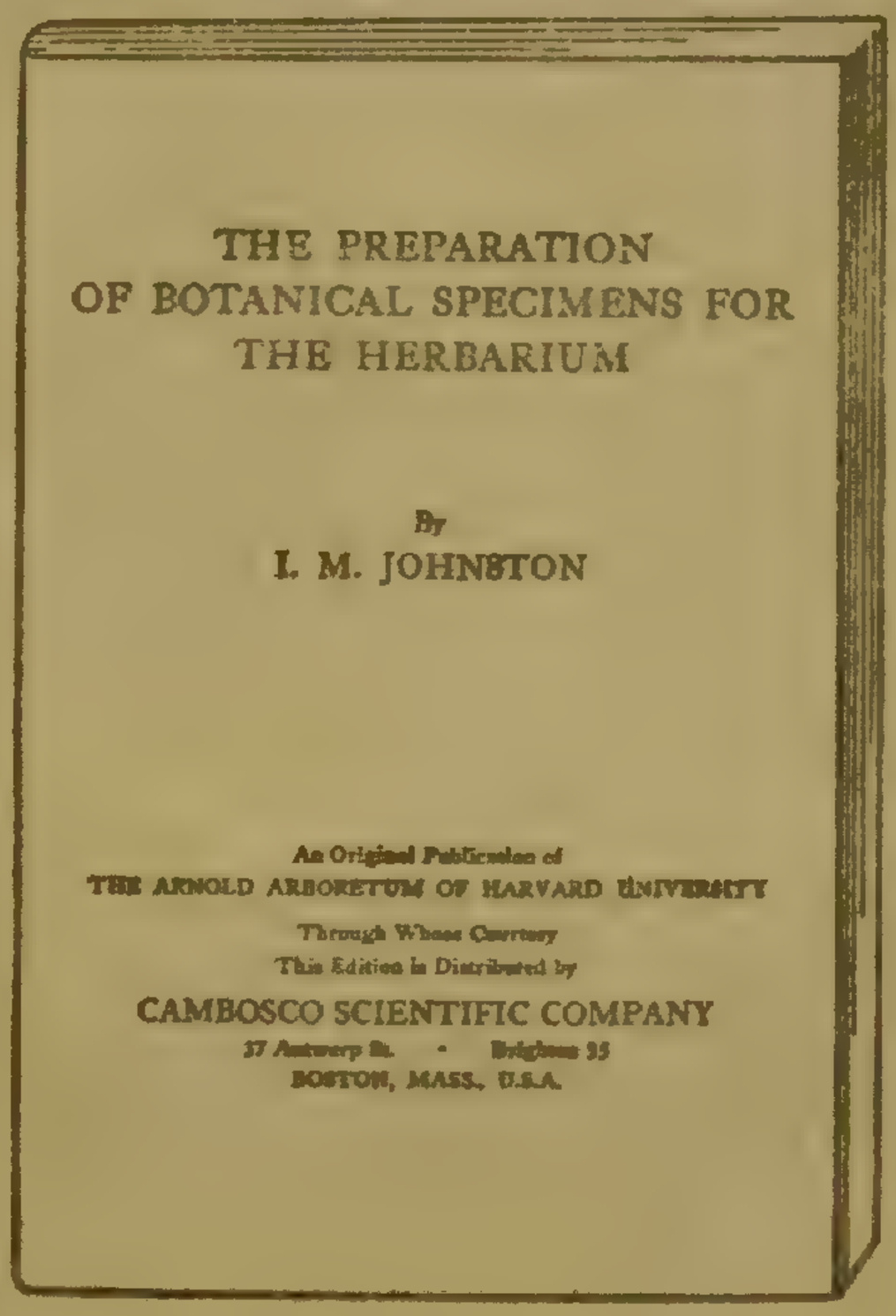

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American Fern Journal

VOL. 49 APRIL–JUNE, 1959 NO. 2

Frederick Louis Fagley, 1879–1958

C. V. MORTON[1]

Dr. Frederick Louis Fagley, President of the American Fern Society in 1945, 1946, and 1947, was born in Bethel, Ohio, May 8, 1879. He received his degree of D.D. from Oberlin College and thereafter devoted the remainder of his life to the service of the Church. He soon demonstrated great administrative ability and was Associate Secretary of the General Councils of Congregational Christian Churches from 1922 until his retirement in 1948. He was especially interested in Church History and was one of the founders of the Congregational Historical Society. Among other activities he served on the executive committee of the Federal Council of Churches, served as chairman of a national committee for Army and Navy chaplains during the war, directed the National Council's German Exchange Program after the war, initiated the Fellowship of Prayer and served as editor of "Daily Devotions." For a time he was Dudleian Lecturer at Harvard University (1951–52). He will be best remembered as the author of "The History of American Congregationalism," with Dr. Gaius Glenn Atkins.

There was nothing provincial or parochial about Dr. Fagley; he was a man of liberal outlook, and his interests ranged from art (he was a director of the National Arts Club) to plants. Ferns, in particular, were a long-time

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[1] I am grateful to the Gramercy Graphic, New York, and the Bulletin of the Congregational Library, Boston, for information.

[Volume 49, Number 1, of the JOURNAL, pp. 1–64, was issued April 13, 1959.]

hobby; he took great pleasure in growing and studying them on his summer place on the shores of Lake Sunapee in New Hampshire.

It was during Dr. Fagley's terms as President of the Fern Society that the long association between the Brooklyn Botanical Garden and the Fern Society was terminated. He very competently directed the negotiations that resulted in the library and herbarium being transferred to the Missouri Botanical Garden and the stock of back-numbers of the Journal being brought to the Smithsonian Institution.

It was a privilege to have been associated with Dr. Fagley. He had an affection and respect for the old and traditional, as his historical interests testify, and also a zest for the new and the untried. As many have reason to know, he was always ready with wise counsel and warm friendship.

The Identification of a Costa Rican Blechnum

C. V. MORTON

There is a group of species of *Blechnum* of striking aspect, noted in Mr. Horich's accompanying article. They are cycad-like, with erect, stocky trunks, and stiffly erect, coriaceous leaves. They grow mostly in open exposed meadows at high elevations, or in far southern, subantarctic regions. The best known of these is *B. tabulare*, of South Africa, with which most of the other species have been identified at one time or another. Doubtless, many of them are distinct, although in just what characters has never been altogether certain. The Brazilian form is *B. imperiale* (Fée & Glaz.) Christ, that of the Guianas is *B. Schomburgkii* (Klotzsch) C. Chr., that of Colombia *B. columbiense* Hieron., that of Bolivia *B. Buchtienii* Rosenst., that of Patagonia and southern

Chile *B. magellanicum* (Desv.) Mett., that of Juan Fernandez Island *B. cycadifolium* (Colla) Sturm, and that of Costa Rica *B. Werckleanum* (Christ) C. Chr.

In addition to the arborescent character, these species all have characteristic scales—curved, long-linear, entire, bicolorous, thickened at the center and several cells thick. These scales occur only on the trunk and the base of the stipes. They must be considered as distinguishing a group more than the trunk, which occurs also in some other unrelated species of *Blechnum*, such as *B. brasiliense*.

It appears that, considered conservatively, the genus *Blechnum* can be divided into two subgenera—*Blechnum* and *Lomaria*. The latter has often been regarded as generically distinct, but the only character is that of having dimorphic sterile and fertile blades, which is not necessarily a generic character in ferns and which in this case is rather vague and variable; there are some species of subg. *Blechnum* with subdimorphic blades and some of *Lomaria*, at least exceptionally, with subconform blades

Several subdivisions of *Lomaria* have been proposed, rather casually. John Smith[1] recognized four groups, the category of which is not definitely stated but which can be assumed to be sections, in accordance with the usual nomenclatural practice of his time. They are named *Lomaridium*, *Stegania*, *Loxochlena*, and *Lomariocycas*. The latter group included a large number of species—among them *L. Gilliesii*, *L. procera*, *L. capensis*, *L. gibba*, *L. Fraseri*, and *L. Boryana* [i.e. *Blechnum tabulare*]. Apparently the name *Lomariocycas* has never been taken up by a subsequent author, and is thus still untypified. According to my present views, the species enumerated by Smith belong to several sections. However, the one that is especially commented on by Smith, and the one that doubtless occasioned the coining of the

[1] Historia Filicum 302–306. 1875.

descriptive name *Lomariocycas* is *L. Boryana*, which can conveniently be designated as the lectotype.

BLECHNUM L. Sect. **Lomariocycas** (J. Smith) Morton. *comb. nov.*

Lomaria [Sect.] *Lomariocycas* J. Smith, Hist. Fil. 305. 1875.

Lectotypus: *Lomaria Boryana* (Swartz) Willd.

The only species of this group to be reported from Costa Rica is *B. Werckleanum*, mentioned above, which was described from an unstated locality on material collected by Wercklé. It has been collected at several localities—Vara Blanca de Sarapiquí (between Poás and Barba volcanoes), between Las Nubes and La Palma, on the Cerros de Zurquí and Cerro de las Caricias, north of San Isidro in the Province of Heredia, and at El Boquete, on Volcán Chiriquí, in Panama. The sterile pinnae in this species are slenderly long-attenuate at the apex or sometimes rather abruptly caudate. Little is known about its habit; it may not have a very thick or conspicuous trunk, because the labels on the specimens do not comment on the fact.

There is a second species of this group known from Costa Rica—the one growing in the "páramos" of the Sierra de Talamanca, Province of Cartago, and of the Laguna de la Chonta, northeast of Santa Maria de Dota, Province of San José. Specimens from the latter locality collected by Paul C. Standley were considered a new species by Dr. Maxon and assigned a specific epithet in honor of the collector; however, Maxon never got around to describing this species. The pinnae are obtuse at the apex and not at all attenuate or caudate. In preliminary studies that I made of *Blechnum* some years ago I was unable to distinguish this species from the South American *Blechnum Buchtienii* Rosenstock, which was described originally from Unduavi, North Yungas, Bolivia (*Buchtien* no. 878), which was collected at the extreme

altitude of 3800 meters. However, this species is now known to occur commonly in the páramos of Colombia and Ecuador, where it has been found by most collectors. A reexamination of the material satisfies me that the Costa Rican plant can correctly be called *B. Buchtienii;* if there are any differences they are not apparent from herbarium material.

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The Home of Blechnum Buchtienii in Costa Rica

C. K. HORICH

The high mountains of Costa Rica are isolated from the Guatemalan highlands by the lowlands of Nicaragua and from the Andes of South America by the Isthmus of Panama. They reach the highest points of elevation in the southernmost Cordillera de Talamanca, which is continuous with the high mountains of western Panama in the region of the Volcán Chiriquí. The very uppermost elevations provide the only stretches, comparatively diminutive in size, in Central America of the tundra-like "páramo" conditions so typical of the high Andes, with the possible exception of the isolated Cerro María Tecún in Guatemala, on the boundary between the Departments of Totonicapán and Sololá.

In these "páramos" occur a number of rare and interesting endemics, such as the bromeliads *Puya dasyliri-oides* and *Greigia sylvicola*, a species of "sundew," *Drosera* (not reported from Costa Rica in Standley's "Flora of Costa Rica"), *Gentiana sedifolia*, and a number of species of Ericaceae. Among the pteridophytes growing in this region are species of *Lycopodium* and *Jamesonia*, the fern genus that is typical of South American "páramos," and even an extremely rare *Isoëtes*, half-submerged in open ponds in sphagnum bogs near the Cerro de la Muerte ("The Death Mountain"). These

Top, Blechnum Buchtienii in open bog in Cordillera de Talamanaca; below, one of the largest specimens, with the author in foreground

plants grow at elevations between 2500 m. and 3300 m. or more.

The climatic conditions prevailing throughout the regions of the Cerro de las Vueltas, Cerro de la Muerte, Cerro del Nivel, Cerro de Urén, Cerro Chirripó Grande, Derro Durika, and the Cruz del Abispo rank among the most disagreeable that one could find—a continuous succession of fog, drizzle, heavy rain, and cold, howling winds. There are immense stretches of deep, virgin cloud-forests in these mountains; it is only on the most exposed situations, located in saddles where the water can not drain off immediately, that we find the sphagnum bogs and "páramos."

It is in this bleak, almost sinister world of white fog that we meet with *Blechnum Buchtienii*, a fern so strange in appearance that even competent botanists confuse it with a species of cycad. The thick, stiff, leathery fronds spread star-like from the top of a thick stem that becomes more than eight feet in height in old specimens. It is more deeply rooted in the swamp and tougher in structure than any other tree-fern that I have seen. The stout, stiff appearance of this *Blechnum* and the regular, symmetrical growth of the narrow, glossy fronds is responsible for the strange superficial similarity to cycads such as *Dioon*, a similarity that prevails even in young specimens. However, an investigation will soon reveal the fertile, spore-bearing fronds, hardly different in aspect from the sterile.

The trunks of *Blechnum Buchtienii* are often host to small epiphytic plants, including a species of *Asplenium* and miniature orchids of the genera *Pleurothallis* and *Lepanthes*.

When the trees lose their anchoring in the high winds and fall down on the mats of sphagnum moss they sometimes will root throughout their entire length in the boggy ground.

This *Blechnum*, a remnant of an ancient "páramo" element that may have once covered most of the higher slopes in Costa Rica, is certainly an outstandingly interesting fern, and also a very decorative plant. It might be possible in cultivation in cool, wet, acid soil, with its stem wrapped in live sphagnum moss. The region in which it grows merits conservation.

Lista de Correos, San José, Costa Rica.

Remarks on Some 1958 Dealers' Catalogs

C. V. MORTON

One of the frequent requests received by the officers of the American Fern Society is for information as to sources of supply for ferns, both hardy and house (or greenhouse) kinds. For this reason I wrote to a number of dealers for current catalogs of their offerings. The following are some casual remarks on those received.

The largest dealers are those supplying the trade—florists' shops, ten-cent stores and so forth—and these usually do not wish to bother with small retail orders. Some of the best dealers apparently do not issue catalogs at all, depending on general advertisements. Some consideration has been given to the possibility of having a few pages of dealers' advertisements at the back of the Fern Journal as a service to our members rather than as an income-producing proposition, but the response has not been encouraging. Apparently there is a feeling that the membership of the Fern Society is too small to make advertising profitable in the Journal. It is true that the subscription list is relatively small compared with many popular periodicals, but still it is highly selective in that it includes a large number of those people in the States that are truly interested in ferns and in growing ferns.

Stocks do vary, and doubtless some of the dealers men-

tioned below have additional species available but in quantities too small to merit advertising. Inquiries can be made by letter.

One of the most reliable plant dealers is Wayside Gardens, Mentor, Ohio, whose catalogs are things of beauty. Ferns are by no means a specialty, and only six hardy kinds are offered—*Adiantum pedatum*, *Polystichum acrostichoides* [as *Aspidium acrostichoides*], *Dryopteris spinulosa* [as *Aspidium spinulosum*], *Athyrium filix-femina* [as *Asplenium filix-foemina*], *Osmunda cinnamomea*, and *Osmunda Claytoniana*.

Gardens of the Blue Ridge, Ashford, North Carolina, offers plants of about 25 species of hardy eastern ferns, as well as many native eastern flowers and shrubs, including the interesting and seldom used native ground-covers *Galax aphylla*, "Oconee Bells" (*Shortia galacifolia*), wintergreen (*Gaultheria procumbens*), and trailing arbutus (*Epigaea repens*), and the most spectacular and beautiful of native trees, the fringe-tree (*Chionanthus virginicus*), not enough used in gardens. The proprietor, Mr. E. C. Robbins, is to be congratulated on the careful and professional way in which his catalog is drawn up, with practically all the names right, and correctly spelled, a marked contrast to many dealers' catalogs.

Twenty-seven kinds of hardy ferns native to the eastern states are offered by Harry E. Saier, Dimondale, Michigan. Ferns are a very casual sideline with Mr. Saier, who specializes in seeds of flowers, shrubs, and trees; his catalog is the richest I know of in rare plants.

A feature of the catalog of Vick's Wildgardens, Inc., Box 115, Gladwyne, Pa., is that all the stocks are nursery-grown; it is good to know that some dealers are not raiding the dwindling supply of wild plants. The ferns offered are all hardy eastern species, including club-moss (*Lycopodium lucidulum*), ground-pine (*L. obscurum*), and ground-cedar (*L. complanatum* var. *flabelliforme*, to

judge from the illustration). A crossing of the names between the drawings of polypody and New York fern will not confuse readers of the Fern Journal.

Plants of hardy eastern ferns are offered also by Sky-Cleft Gardens, Camp Street Extended, Barre, Vermont, altogether 31 species, all natives of the eastern states except the deer-fern, *Blechnum Spicant*. The same firm offers also hardy rock garden and alpine plants.

One of the best catalogs for house and greenhouse plants is from Merry Gardens, Camden, Maine, which offers a large selection of various geraniums, tuberous begonias, foliage plants, and succulents. A number of tender ferns are offered, including mother-fern (*Asplenium bulbiferum*), bird's-nest-fern (*Asplenium nidus*, erroneously called *Asplenium nidus-avis*, as it is in many other dealers' catalogs), *Davallia Mariesii* and *D. Griffithiana* (a real rarity, if it is correctly named), *Nephrolepis* cv. '*Compacta*,' cv. '*Duffii*,' cv. '*Verona*,' and cv. '*Whitmanii*,' *Pteris* cv. '*Victoriae*,' cv. '*Wilsonii*,' *Selaginella Brownii*, *S. Kraussiana*, and others. It is rather too bad to continue to find the flowering plants asparagus (*Asparagus plumosus* and *A. Sprengeri*) and "babies'-tears" (*Helxine*) listed as ferns. I am sure that the compilers of the catalog know better but feel impelled to go along with the irradicable popular idea that asparagus is a fern, but there seems to be no reason at all for classing *Helxine* as a fern, for it is anything but fernlike and is not thought of as a fern by gardeners, who think of it as a ground cover of the same class as *Dichondra*. It might be mentioned that the photograph labelled *Polystichum aculeatum* certainly does not represent this species; it is apparently the plant called *P. coriaceum*, which is now properly called either *Polystichum adiantiforme* or *Rumohra adiantiformis* (the "leather-fern" of commerce).

One of the better offerings of house ferns and green-

house varieties is from Tropical Paradise, 3810 Bales Avenue, Kansas City 28, Missouri, which is run by one of our members, Mrs. H. E. Dillard. Among the plants offered are *Blechnum brasiliense*, *B. gibbum*, *Davallia fejeensis* and *D. Mariesii*, *Microlepia speluncae*, *Woodwardia orientalis*, several kinds of tree-ferns, and various cultivars of *Nephrolepis* and *Pteris*. *Adiantum curvatum* is listed, an excessively rare species, if it is correctly named. The same might be said of the plant listed as *Davallia tenuifolia*, which, if correctly identified, is a synonym of the plant properly called *Sphenomeris chinensis*. In addition to ferns, Mrs. Dillard specializes in begonias and Gesneriaceae. Unfortunately, her catalog is marred by numerous misspelled scientific names.

Another firm offering a few ferns for house plants is Barrington Greenhouses, 860 Clements Bridge Road, Barrington, New Jersey. The ferns are mostly a rather common lot, but some of the other greenhouse plants offered are exceedingly rare, including a number of Gesneriaceae. The catalog is much more carefully made up and edited than many are; brief descriptions of many of the novelties are included.

A few house ferns are offered by the Country Greenhouses, Cook Hill Road, Danielson, Connecticut, along with many geraniums, fuchsias, begonias, and other tender plants.

For California growers and for those elsewhere with greenhouses, the California Jungle Gardens, 11977 San Vicente Boulevard, Los Angeles 49, California, can be recommended. This firm specializes in large-leaved exotic plants, such as palms, cycads, bromeliads, and species of the banana, elephant-ears, and ginger families. A number of larger ferns are offered, including some that are perhaps not offered elsewhere—*Sadleria cyatheoides*, *Aglaomorpha* [*Polypodium*] *coronans*, *Aglaomorpha Meyeniana*, *Davallia solida*, *Adiantum trapeziforme*, and

nine kinds of stag-horn ferns (*Platycerium*), the latter quite expensive ($5.00 to $15.00 each), but reasonably so, for propagation of these plants is a slow and tricky business. One intriguing entry is an offering of a fern called "*Pellaea virgata,*" said to be a "stunning fern that looks much like a fine, large-leaved *Adiantum.*" I can not guess what it may be; so far as I know, there has never been a plant described botanically as *Pellaea virgata.*

A few western ferns are offered by Theodore Payne, 2969 Los Feliz Boulevard, Los Angeles 39, California—*Adiantum pedatum, Dryopteris arguta* (called in the catalog by the old name *Aspidium rigidum argutum*), *Athyrium filix-femina* var. *californicum, Polystichum Dudleyi,* P. *munitum, Pteridium aquilinum* var. *pubescens* (called in the list *Pteris aquilina lanuginosa,* an obsolete nomenclature), and *Woodwardia Chamissoi* (now correctly called *Woodwardia fimbriata*). Mr. Payne specializes in seeds of Californian wildflowers and plants of western trees and shrubs.

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A Study of the Filmy Fern Trichomanes Boschianum

ROBERT H. MOHLENBROCK AND JOHN W. VOIGT

The filmy fern *Trichomanes Boschianum,* one of eastern North America's rarest ferns, has been known to occur at a single station in Illinois since 1923. Recent visits to this station by the authors show the species still to be thriving. Its unusual presence in Illinois has led the authors to make a study of this fern in regard to its history, morphology, ecology, geography, and past collections.

The authors are indebted to the Missouri Botanical Garden for privileges granted to them in the library and herbarium, and to Mr. Raymond E. Hatcher, whose collection of Illinois bryophytes was utilized.

HISTORY

Trichomanes Boschianum became known to science through its discovery by Judge Thomas M. Peters in 1853. On January 8 of that year, while exploring near the Sipsey River in the upper part of Hancock County (now Winston County), Alabama, Judge Peters discovered two kinds of ferns that he had not seen before on wet sandstone bluffs. Puzzled by his new finds, he sent material of each to Professor Asa Gray for determination. Gray reported his identifications of the specimens in a paper entitled "On the discovery of two new species of *Trichomanes* in the state of Alabama, one of which is new."[1] In this report, Gray described the smaller species as new, naming it *Trichomanes Petersii* after its discoverer. The other specimen he called *Trichomanes radicans*, a species known previously only from the tropics and subtropics. For eight years, this material went by that name. In 1861, Johann Wilhelm Sturm, working on the Hymenophyllaceae, concluded that the Alabama specimens were specifically distinct from *T. radicans*, and described them as *Trichomanes Boschianum* in honor of his contemporary Roelof Benjamin van den Bosch, one of the most ardent students of the filmy fern family.

MORPHOLOGY

Trichomanes Boschianum is perennial and evergreen with leaves either erect or, more usually, pendent. The slender, creeping, wiry rootstocks are black or deep brown and often widely branching. They are covered with numerous deep brown filamentous hairs, these being most abundant where the leaves are attached. The abundance of hairs diminishes as the plant becomes older.

The light green, translucent leaves, which are only

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[1] Amer. Journ. Sci. II, 15: 324, 325. May, 1853.

one cell in thickness (hence the name filmy fern), are lanceolate or sometimes ovate-lanceolate and bi- or tripinnatifid. In one specimen from Alabama (*Underwood s.n.*), the fronds taper to the tip. The segments are ovate and cut into linear divisions. The degree of cutting varies considerably—in *House* 2096 from South Carolina and *Harvill & Segars* 803, from Alabama, the leaves are much dissected, and in *Rule* 1756, from Kentucky, the divisions are more shallow and fewer in number. Several gradations occur between these extremes. The tips of the ultimate segments are mostly obtuse, and particularly so in *Spear s.n.* from Alabama. The leaves range from 8 to 20 cm. in length and are without stomata. The winged rhachis is green when young, becoming brown or black with age. It occasionally bears short hairs beneath. The brown to black stipes are relatively short (15–55 mm.) and are translucently winged, except near the base. These, too, are sometimes beset with short brown hairs.

The venation is free, with the tips of the veins often forking into the usually slightly bidentate apices of the ultimate leaf segments. The veins are composed of several layers of tissues. The sori are terminal on the veins. The indusia are urn-shaped with the lower part immersed in the leaf tissue. There may be one to four indusia in each segment, arising from the leaf in the short lobes or from the sinuses between these lobes. They are 2–5 mm. long and truncate at the apex. From the indusium the bristle-like receptacle (columella of Williamson, 1878) arises. It may reach a length of nearly ten millimeters. From it are produced numerous small sporangia in a spiral arrangement. The receptacle usually persists long after the sporangia have been shed. The lower and younger sporangia are sheathed by the indusium; the upper and older are not concealed. The sporangia are short-stalked and thin-walled, with a transverse annulus that dehisces obliquely.

The seldom-observed gametophyte is filamentous and much branched and reminiscent of some filamentous green algae.

ECOLOGY

Like most members of Hymenophyllaceae, *Trichomanes Boschianum* is a plant of moist, shaded areas. It occurs beneath overhanging rocks of very moist sandstone and is usually at all times out of the sun's direct rays. Zuck (1939) reports it occurring on exposed siliceous rocks in Monroe County, Tennessee. Frequently it grows in grottoes just a few feet from limpid pools of water or near falls where the spray of water helps to keep the fronds continually moist. An analysis of the sandstone substratum shows it to be acidic. Coker (1938) reports the surface pH from the North Carolina station to be 5.45 and the interior pH to be 6.54, taken with a Beckman pH meter. At the Illinois station, spring water issuing from beneath the bluff had a temperature of 57° F. on August 11, 1957.

The leaves of the filmy fern are adapted to moist shaded conditions by their one-celled thickness and absence of stomates.

In North Carolina, Coker (1938) listed *Asplenium Trichomanes* and *Asplenium montanum* as associates of the filmy fern. In their discussion of the hemlock in Alabama, Segars, *et al* (1951) listed *Trichomanes Boschianum* as an associated species, along with *Asplenium montanum*, *Asplenium pinnatifidum*, *Trichomanes Petersii*, *Diphyscium cumberlandianum*, *Mnium punctatum*, *Rhodobryum roseum*, and *Tetraphis pellucida*. The phanerograms included *Orchis spectabilis*, *Juglans cinerea*, *Betula lenta*, *Trautvetteria caroliniensis*, *Thalictrum clavatum*, *Boykinia aconitifolia*, and *Heuchera parviflora* var. *Rugelii*. These authors suggest that there may be botanically significant differences in the micro-

Trichomanes Boschianum on base of a shaded sandstone bluff in Jackson Hollow, Illinois

climate between the places where hemlock (and hence filmy fern) occurs and other areas.

The elevation of the stations for this species ranges from 560 feet above sea level in Pope County, Illinois, to 3000 feet in Macon County, North Carolina. The Pope County station, Illinois, is in a great sandstone ravine called Jackson Hollow. It was first discovered by Mary Steagall in 1923 and later rediscovered by Julius R. Swayne in 1950. The authors have made several visits to this station during the last four years. The abundance of the species at this station has diminished little during the past thirty years. (*Pl. 6*). The rootstocks of the filmy fern at Jackson Hollow are intertwined among various bryophytes, notably the mosses *Leucobryum glaucum* and *Thuidium delicatum* and the hepatics *Bazzania trilobata* and *Pellia diphylla*. Other cryptogams found on moist sandstone bluffs in the vicinity of *Trichomanes Boschianum* are *Diphyscium foliosum*, *Plagiochila asplenioides*, *Scapania nemorosa*, *Leucolejeunea clypeata*, *Tetraphis pellucida*, *Calypogeia Trichomanes*, and numerous others.

The mesic ravines of Jackson Hollow are dominated by white oak (*Quercus alba*), sugar maple (*Acer saccharum*), and beech (*Fagus grandifolia*), these three making up about 60% of the trees. Flowering dogwood (*Cornus florida*), redbud (*Cercis canadensis*), Hop Hornbeam (*Ostrya virginiana*), white elm (*Ulmus americana*), and white ash (*Fraxinus americana*) are common. Herbaceous species, many of which are unusual in southern Illinois, include three orchids (*Goodyera pubescens*, *Corallorrhiza Wisteriana*, and *Orchis spectabilis*), louse-wort (*Pedicularis canadensis*), liverleaf (*Hepatica acutiloba*), and various sedges including *Carex Jamesii*, *C. Careyana*, and *C. crinita*. Besides the filmy fern, other pteridophytes of note in the area are *Lycopodium lucidulum*, *Dryopteris austriaca* var. *intermedia*, and *Campto-*

sorus rhizophyllus.

GEOGRAPHIC DISTRIBUTION

The family Hymenophyllaceae, containing two large genera (*Hymenophyllum* and *Trichomanes*), is widely distributed, but is most prevalent in the tropics and sub-

FIG. 1. GEOGRAPHIC DISTRIBUTION OF TRICHOMANES BOSCHIANUM

tropics. Most of the species occur in very moist, shaded areas. A few extend northward, including *Trichomanes Boschianum.*

Trichomanes Boschianum has been found in nine states, most of which are in the southeastern section of the United States (*Fig. 1*). It seems to be most frequent

in Kentucky and Alabama. Collections are from 27 scattered counties in the United States. In some counties, it is known from several stations (Winston and Marion in Alabama; Edmonson in Kentucky).

The most northern station for this filmy fern is in Hocking County, Ohio, at about 39°40′ N. latitude. The species extends southward to Hale County, Alabama, at 32°80′. The eastern limit is in Wayne County, West Virginia (82°30′ W.) while the westernmost station is in Pope County, Illinois (89°).

Nearly two-thirds of the collections have been from Kentucky and Alabama. Tennessee has three stations. Two stations are in South Carolina. Single localities are recorded from Illinois, Ohio, West Virginia, North Carolina, and Georgia. Reports of this species from Florida are either in error or are based on specimens no longer in existence.

COLLECTIONS OF THE FILMY FERN

All specimens cited below are in the herbarium of the Missouri Botanical Garden, except the Illinois specimens and *Rule* 1756, which are in the herbarium of Southern Illinois University. The Tennessee citations are taken from Shaver, 1954.

ALABAMA: ETOWAH: Reported by Graves (1920). FRANKLIN: Reported by Graves (1920). HALE: Rocky glen, Havana, December 21, 1898, *Trelease s.n.* JACKSON: Reported by Graves (1920). LAMAR: Shady sandstone cliffs along Buttahatchie River, north edge of county, July 12, 1933, *Harper* 3086. LAWRENCE: Moulton, 1865, *Peters s.n.*; under sandstone cliffs, 1873, *Peters s.n.*; under cliff in canyon at waterfall on Sipsey River in southwestern corner of county, April 11, 1953, *Hardin & Duncan* 15343. MARION: Pikeville, *E. A. Smith s.n.*; on dripping ledge, overhanging sandstone bluffs, along Dugan Creek, near old town of Pikeville, May 21, 1931, *E. J. Palmer* 38988; under overhanging sandstone cliffs on Williams Creek, near its mouth, March 29, 1939, *Harper* 3709. WALKER: Frequent under sandstone cliffs, 1873, *Peters s.n.* WINSTON: Sandstone cliff, 1868, *Peters s.n.*; under projecting

rocks near Sipsey River, T8, R9, sect. 10, June 1, 1896, *Underwood s.n.;* caves in sandstone rocks, September 13, 1897, *Eggert s.n.;* in a Pottsville sandstone rock-house at the Westfork Sipsey River picnic grounds, August 22, 1949, *Harvill & Segars* 803.

GEORGIA: RABUN: Dripping rocks, Rabun Bald, June 1–4, 1906, *House* 2321.

ILLINOIS: POPE: Dripping sandstone, Jackson Hollow, August 2, 1923, *Steagall* 37; near a spring, Jackson Hollow, T11S, R5E, sect. 31, August 17, 1950, *Swayne* 1136; Jackson Hollow, September 15, 1951, *Evers* 32657.

KENTUCKY: BARREN: 1873, *Hussey s.n.* CARTER: 1872, *Hill s.n.;* 1874, *Hussey s.n.* EDMONSON: July, 1874, *Hussey* 1986; August, 1878, *Hussey* 3767; Indian Hill, Brownsville, under sandstone cliff, July 16, 1896, *Price s.n.;* the Gulf, July 5, 1897, *Price s.n.* LAUREL: Near Rock Castle Springs, August, 1876, *Rule* 1756. LAWRENCE: Without locality or date, *Crandall s.n.* MCCREARY: Near Yamacraw, April 15, 1950, *Reed* 18571. MORGAN: Between Wrigley and Blaze, March, 1950, *Reed* 18303. POWELL: Nada Tunnel, October, 1949, *Reed* 17505. ROCK CASTLE: Under dripping sandstone rocks on Wild Cat Mountain, near Livingston, *Williamson s.n.* WARREN: Honaker's Ferry, August, 1892, *Price s.n.* WHITLEY: Under a shaded moist rock shelter, June 9, 1940, *McFarland, Templeton, Shacklette, & Duncan* 28. WOLFE: Sky Bridge State Park, March, 1948, *Reed* 10913.

NORTH CAROLINA: MACON: In the deep Cullasaja Gorge, on Crow Creek, under the largest falls, 1938, *Hechenbleikner s.n.*

OHIO: HOCKING: Reported by Schaffner (1935).

SOUTH CAROLINA: OCONEE: Tamassee Falls, 1700 feet, May 5, 1906, *House* 2096. PICKENS: Near Laurel Fork Creek, Nov. 12, 1954 (reported by Darling, 1955).

TENNESSEE: FRANKLIN: Natural Bridge, Sewanee, *Shaver* 9839. MONROE: Calderwood Lake, 1939, *Zuck.* SCOTT: No Business Creek, *Sharp, Shanks, & Clebsch* 3971.

WEST VIRGINIA: WAYNE: Under dripping sandstone cliff, one mile from Stiltner, May 11, 1938, *Gilbert & Plymale* 712.

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A Note on Chromosome Numbers in Some Indian Species of Equisetum

P. N. MEHRA AND S. S. BIR

Equisetum Linn. is one of the oldest living genera of vascular plants and is also the sole living representative of a large and ancient group Equisetales. It comprises about twenty-five species (Billington, 1952) of world-wide distribution except for Australia and New Zealand. For this reason a comparison of the cytological constitution of various species from different parts of the world is desirable.

A study of the available literature (Clarke, 1880; Baker, 1887; Stewart, 1951; and Schelpe, 1954) shows that only four species of the genus, namely *E. arvense* L., *E. diffusum* D. Don, *E. ramosissimum* Desf. (syn. *E. elongatum* Willd.), and *E. debile* Roxb., have been reported so far from India. Another species, *E. robustum* A. Br., was reported to have been collected at Lahore by Jacquemont and in Pondichery by Belanger (cf. Clarke, *l.c.*; Baker, *l.c.*). However, Clarke pointed out that there are no Indian specimens in the Kew bundle of *E. robustum*. Since that time there is no record of this species having been collected in any part of India and inasmuch it is a species of the North American continent (cf. Baker, *l.c.*, and Manton, 1950), it is doubtful that it actually occurs in India at all.

The cytology of all these species except *Equisetum debile* has remained to be worked out. The latter was studied by Ninan (1955) on material from southern India. The present report records the chromosome number of this species from northern India and in addition those of two other Indian species for which there has been no previous data. These two species, namely *E. diffusum* and *E. ramosissimum* var. *altissimum* A. Br., are usually inhabitants of hills and are common between

5,000 to 7,000 ft. altitude in the Himalayas. Both of these are abundant at Mossy Falls and Burning Ghat, Mussoorie, in the Western Himalayas. At Darjeeling in the Eastern Himalayas, the former species is common by roadsides, and individuals of the latter occur singly among the tea bushes near Lebong. Typical *E. ramosissimum* is reported to occur in Pahlgam, Kashmir (Stewart, 1951). It is interesting to note that in April the young individuals of *E. diffusum* are characterised by the presence of 1–3 underground tubers and very rarely the specimens collected in September also bear these (*Pl. 7, f. 1*). There is no previous mention of the presence of tubers in this species. It seems that the earlier collectors gathered the specimens only in mature condition when the tubers are gone. These tubers generally consist of one long swollen internode. The shoots arising from the nodes of the rhizome have stunted growth and these develop as the short thick tubers. *E. ramosissimum* var. *altissimum* is characterised by its rather large size (up to 10 ft.) and in having a thick stem with a large central cavity. The main stem is simple or branched; in the latter case up to six ascending branches are present at the upper nodes only. The third species, *E. debile*, has been reinvestigated from a cytogeographic point of view. It is very common along river banks and water channels throughout Panjab, ascending up to 2,000 ft. in the Kangra District.

Medium-sized cones collected from wild sources were fixed in 1:3 acetic alcohol for 48–72 hours. The usual acetocarmine squash technique was followed. The preserved material gives good results even after four or five months. Each species was examined from at least two different regions (Eastern and Western Himalayas). It is very easy to get divisions in the cone of *Equisetum* but certain technical difficulties crop up which hinder exact counting. Firstly, the cytoplasm in the spore-mother

Fig. 1. Equisetum diffusum, Mossy Falls, Mussoorie, showing tubers; Fig. 2, Spore mother cell of E. diffusum, showing 108 bivalents at diakinesis, × ca. 745

cells of *Equisetum diffusum* and *E. ramosissimum* var. *altissimum* is slightly granular and stains quickly even if very dilute carmine is used (*Pl. 7, f. 2*). Secondly, the chromosome size and shape are variable and sometimes the shapes are so peculiar as to easily suggest multivalent pairing, this being more prominent in *E. debile* particularly. Thirdly, the chromosomes appear to be brittle

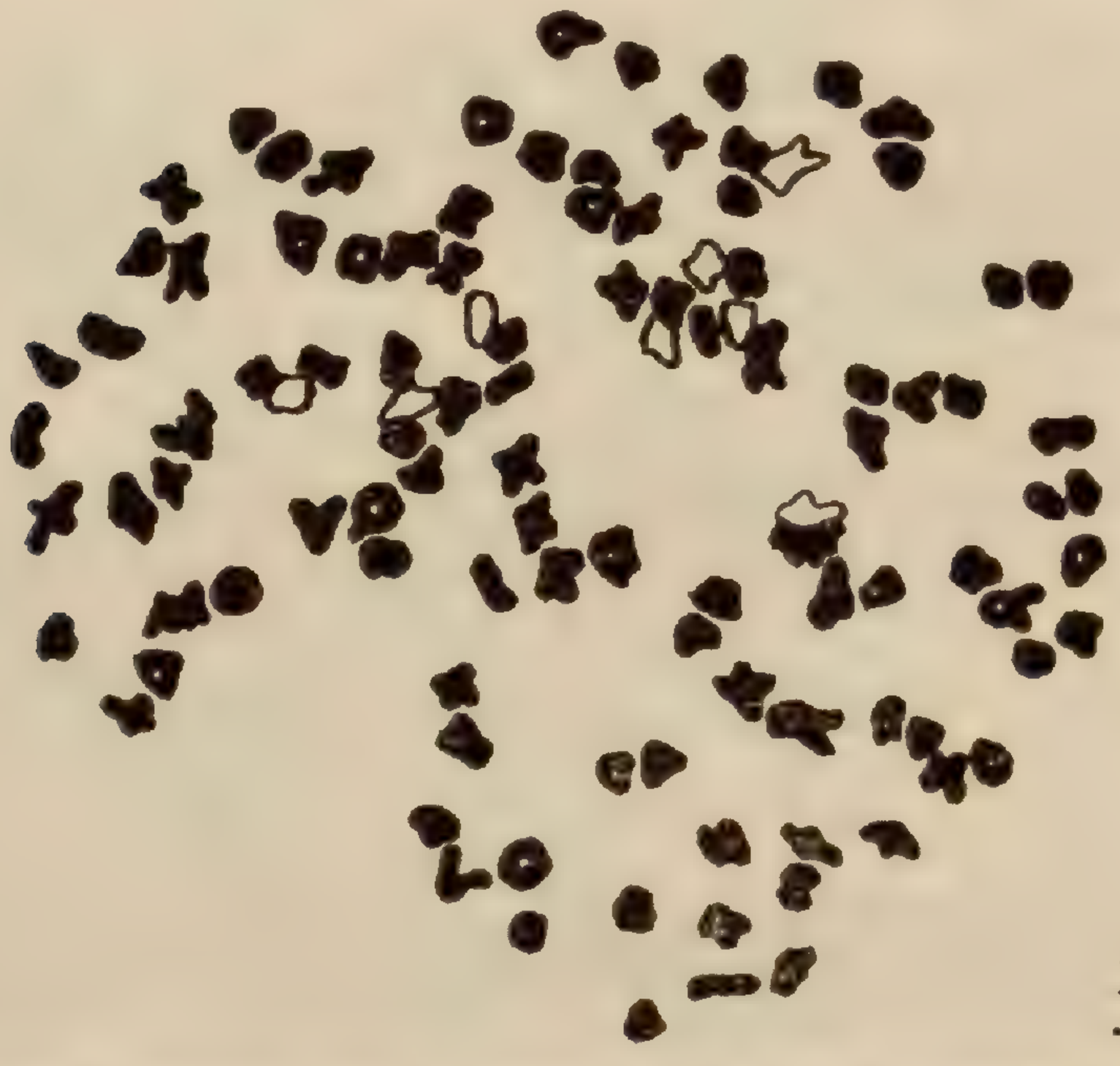

FIG. 3. EXPLANATORY DIAGRAM FOR FIG. 2, SPORE MOTHER CELL OF E. DIFFUSUM; ×870

and may break during squashing even with slight manual pressure. The resulting fragments can easily be mistaken for small individual chromosomes. (*Fig. 4*). So, for exact counting the results were confirmed from large number of spore-mother cells in each case. The size of bivalents at diakinesis is smaller in *E. diffusum* and *E. ramosissimum* var. *altissimum* than in *E. debile*, and they are somewhat more contracted (*Figs. 3* and *5*).

In all the three species the haploid chromosome number is $n = 108$ (*Figs. 2–5*) and thus the results are in conformity with those of Manton (1950) and Ninan (1955). The meiosis is regular resulting in normal well-filled and viable spores. There is no sign of hybridity or chromosomal races in any of the species.

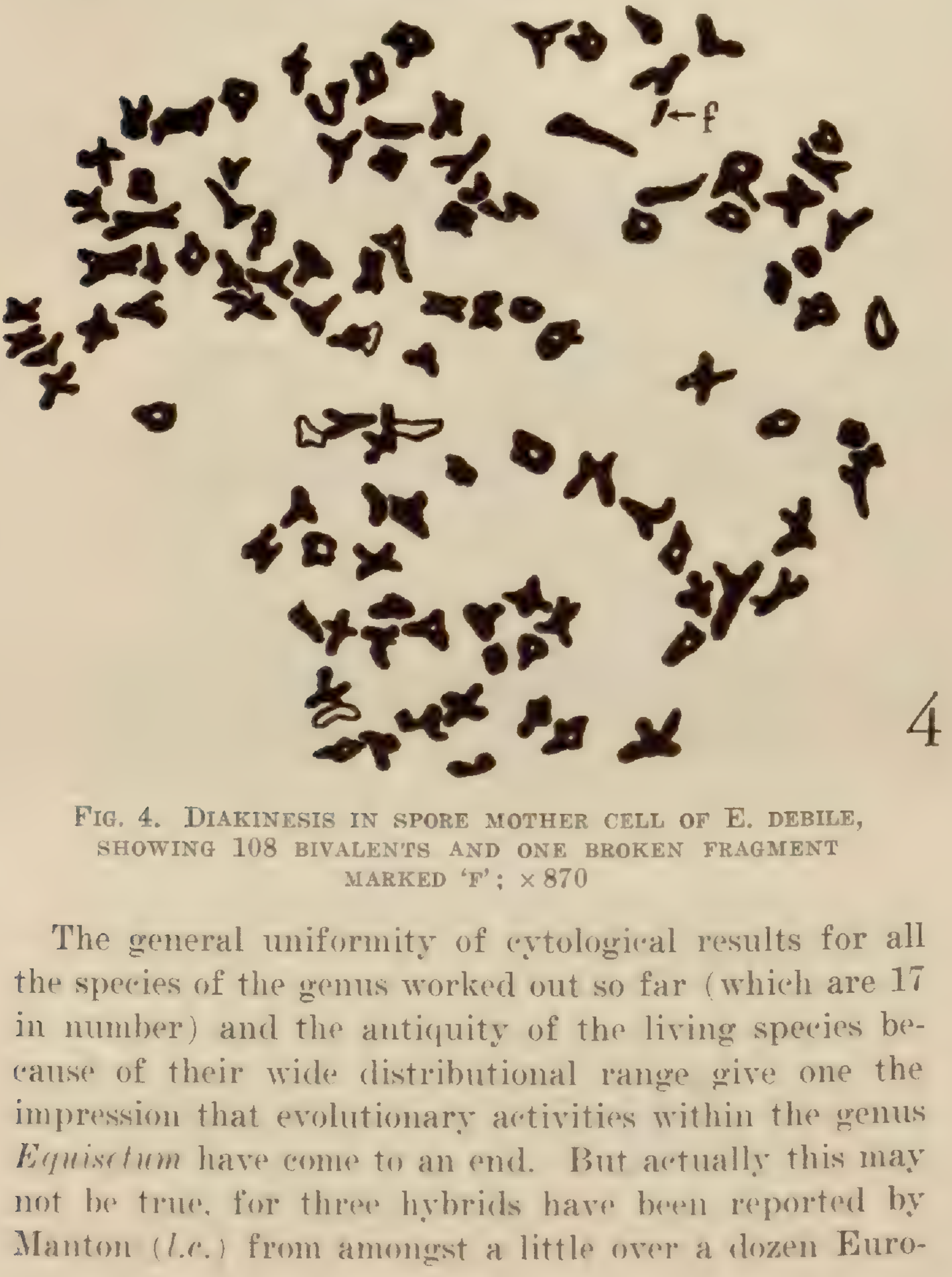

FIG. 4. DIAKINESIS IN SPORE MOTHER CELL OF E. DEBILE, SHOWING 108 BIVALENTS AND ONE BROKEN FRAGMENT MARKED 'F'; ×870

The general uniformity of cytological results for all the species of the genus worked out so far (which are 17 in number) and the antiquity of the living species because of their wide distributional range give one the impression that evolutionary activities within the genus *Equisetum* have come to an end. But actually this may not be true, for three hybrids have been reported by Manton (*l.c.*) from amongst a little over a dozen Euro-

pean species. From this it can be inferred that evolution within the group is still at work to a certain extent, howsoever slow the pace may be, and speciation can possibly occur in the future. So far, about three-fourths of the representatives of the genus have been worked out cytologically.

There is no indication whatsoever of the manner in which the high chromosome number $n = 108$ has been compounded. Whether euploidy or aneuploidy has

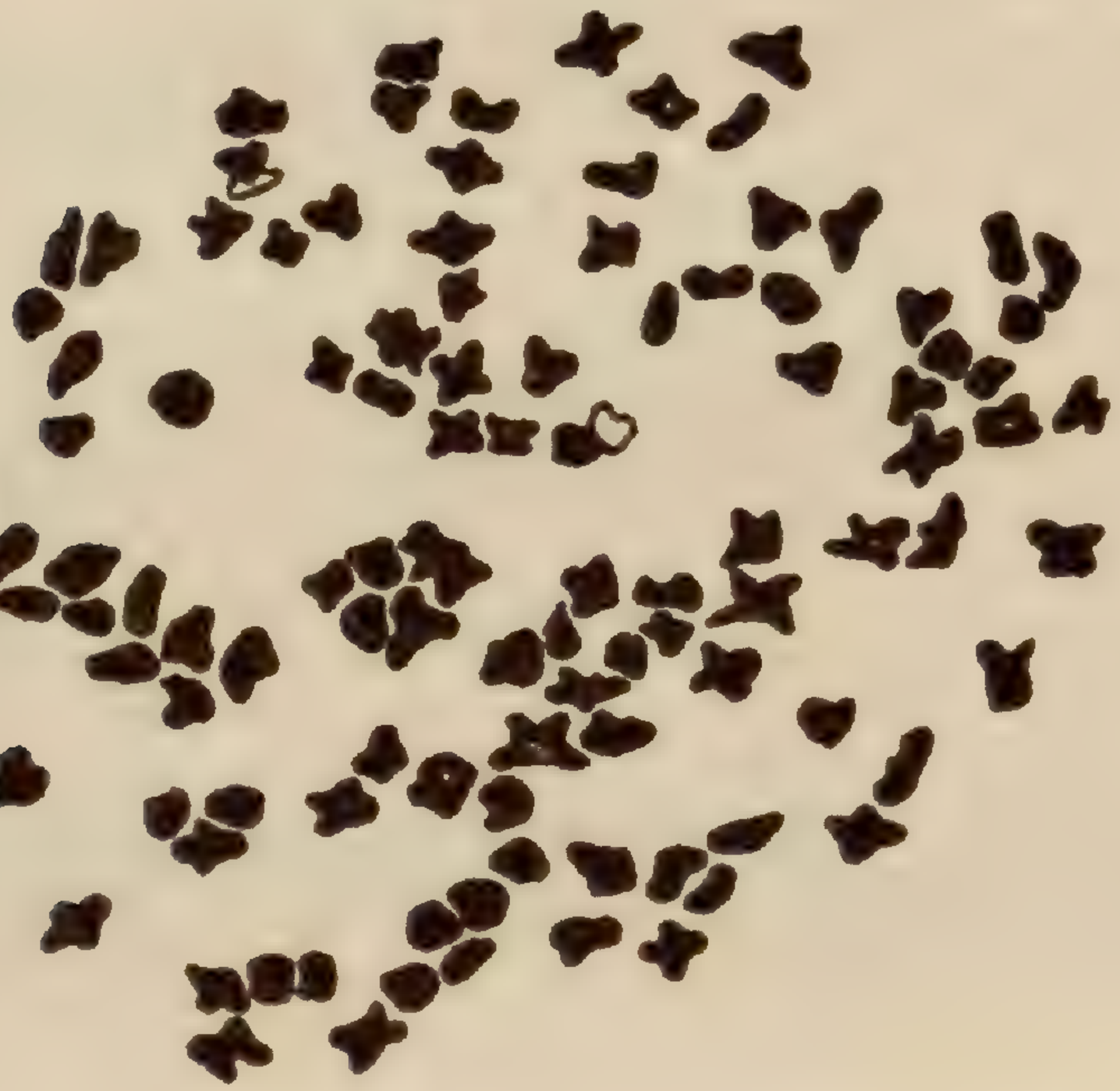

FIG. 5. SPORE MOTHER CELL OF E. RAMOSISSIMUM VAR. ALTISSIMUM, WITH 108 BIVALENTS AT MEIOSIS; ×870

played a part cannot be assessed at this stage unless some member with different monoploid number (high or low) is detected. Here we seem to be dealing with only the upper members of a series whose bases have been lost. The same haploid number for the European (Manton,

l.c.) and Indian (Ninan, *l.c.* and present authors) species of the genus growing in tropical, subtropical, and temperate climates is significant and is in complete contrast to the behaviour of ferns under identical conditions.

We are thankful to Prof. R. R. Stewart for identifying *Equisetum ramosissimum* var. *altissimum* and to Mr. R. S. Pathania for the photographs illustrating this note.

BOTANY DEPARTMENT, PANJAB UNIVERSITY, *Amritsar, India.*

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American Fern Society

Report of the Curator and Librarian for 1958

The most important news of 1958 is the contribution by Professor Edgar T. Wherry, our former President, of a collection of his excellent photographs of ferns and lycosphens to the Society's Library. The collection includes a series of over 400 negatives, representing among them both common and rare species from all over the United States. Each negative is contained in a glassine envelope and is marked with a locality and the year it

was made. The series is divided into families and the species alphabetized within each family. Should any of our members need illustrations for an article, book, or other purpose, let us know the species desired. If available, a glossy print, suitable for reproduction, will be furnished at cost. I am sure that all the members of the American Fern Society join me in expressing our great thanks for this fine contribution.

The over-all use of the Library and Herbarium this year has shown a definite increase over that in 1957. A number of outside loans of books and specimens have been made, and the facilities have also been used frequently by visitors and students on the campus of the University of Michigan. The outside borrowers of books and (or) specimens have included, among others, D. J. Hagenah, I. W. Knobloch, J. Cyrus Lloyd, and Donald Branscomb. Mr. Branscomb kindly contributed over twenty specimens of California ferns to the Herbarium this year. I wish to express apologies for any delays or mix-ups in our service during this period of organization.

It is hoped that during 1959 some of the necessary binding of volumes can be accomplished. There is also a backlog of unmounted and undistributed specimens in the Herbarium to be attended to; for the mounting of specimens it is tentatively planned to use the new plastic mounting technique. In this connection I should like to suggest that collectors contributing mounted specimens avoid the use of scotch-tape in preparing them; we have found this tape to be troublesome and difficult to work with.

For those new members who are still unfamiliar with our procedures, a description of them is given briefly in the bottom paragraph of the inner cover of this Journal.

Respectfully submitted,

WARREN H. WAGNER, JR.

Curator and Librarian

Report of the Spore Exchange, 1958

To those of us who have watched the American Fern Society Spore Exchange grow since its beginning (at the suggestion of Dr. R. C. Benedict), it was gratifying to be able to send out in the fall of 1958 a list of 175 available kinds of spores. All the spores listed have been sent in within the past two years by 46 kind members and friends of the Society. The list was sent out to all those who had contributed or used spores during the last two years or who had expressed an interest in the Exchange—a total of nearly 100 members. The list is still available to anyone requesting it. A supplementary list is now being prepared for distribution which will bring the total number of species currently offered to over 200.

Taking into account 1958 only, contributors slightly outnumbered users, for the first time—contributors numbered 29 and users (who received 203 packets of spores) 21. These seem small numbers compared to the size of the membership as a whole, but each year the number grows a little, and as has been said before in these reports, those who are interested are very, very interested, and express real and sincere gratitude for the privilege of using the Exchange to obtain spores.

Members who are fortunate enough to have greenhouses for their ferns will be interested to know that we have promises of many rare and hard to obtain kinds from several sources in the not too distant future. Reports of these as they arrive will be sent to any members requesting information. (Stamped, addressed envelopes will be appreciated.)

It is earnestly hoped that the friends of the Exchange will again keep it in mind when the 1959 time for fertile fronds comes around where you live or where you vacation. In order to make the exchange of real value, it is necessary that fresh supplies of all ferns be on hand each

year, for fern spores gradually lose their viability. There will always be a goal not quite reached as we strive for a more comprehensive list each year, and for more friends to request spores to have the pleasure and reward of growing them.

Respectfully submitted,
KATHRYN BOYDSTON
Fernwood, Route 3,
Niles, Michigan

SUMMER FIELD-TRIP IN MINNESOTA PLANNED: Tentative plans are under way to hold a field-trip in northeastern Minnesota August 7 and 8, and possibly 9. A start will be made from Duluth and the party will proceed north along the western shore of Lake Superior to Grand Marais, a beautiful region in which some interesting ferns are to be seen. The trip will be led by Dr. Olga Lakela, Department of Botany, University of Minnesota, Duluth, Minn.; enquiries should be addressed to her, immediately.

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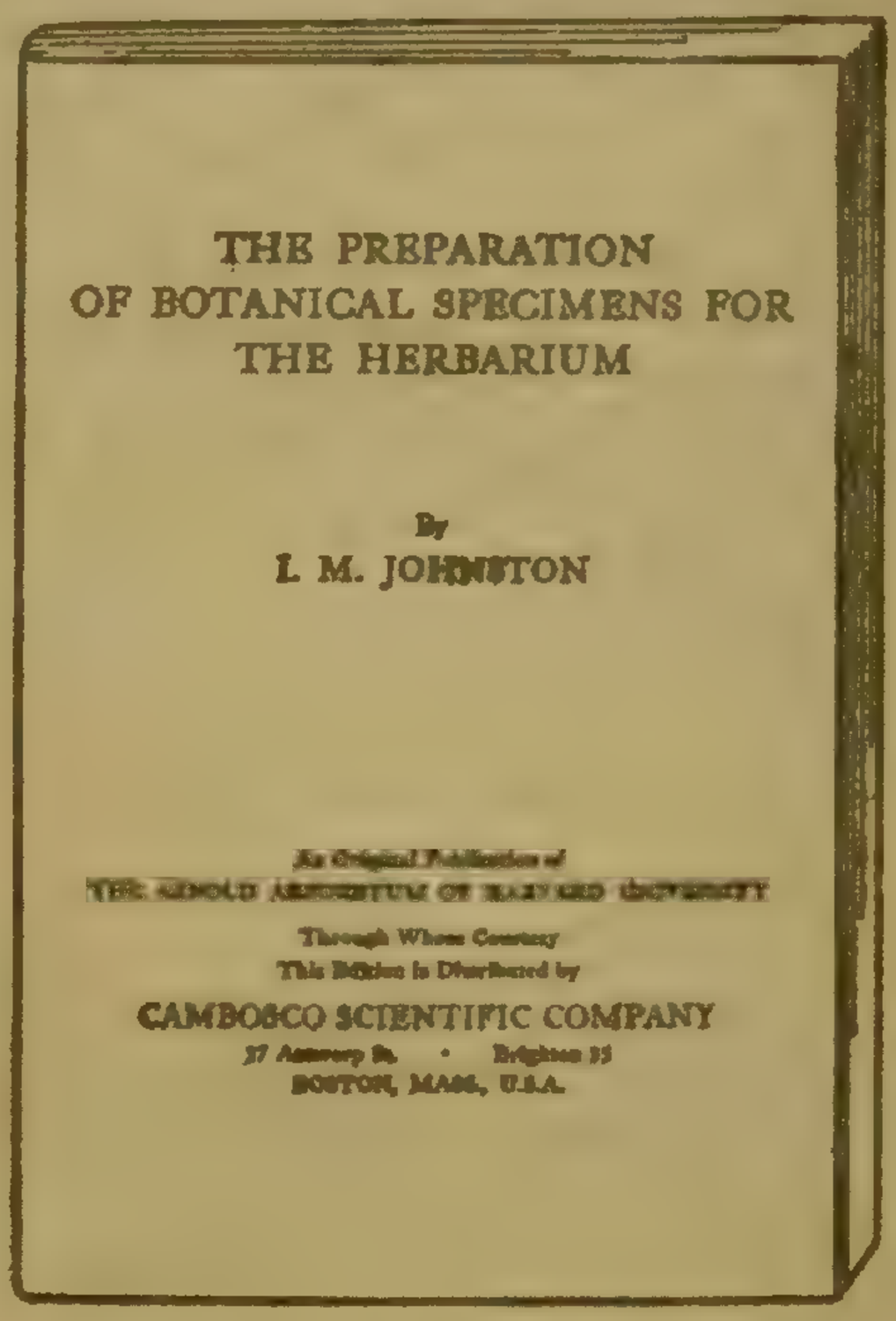

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R. C. BENEDICT IRA L. WIGGINS
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A regular loan department is maintained in connection with the library and herbarium. Members may borrow books and specimens at any time, the borrower paying all postal or express charges. The pages of the Journal also are open to members who wish to arrange exchanges; a membership list is published at intervals, to assist those interested in obtaining specimens from different localities.

American Fern Journal

VOL. 49 JULY–SEPTEMBER No. 3

American Grapeferns Resembling Botrychium ternatum: A Preliminary Report[1]

W. H. WAGNER, JR.

During the nineteenth century the species and varieties of evergreen grapeferns (*Botrychium*, Subgenus *Sceptridium*) in North America were usually identified as *Botrychium ternatum* (Thunb.) Swartz. Underwood[2] in 1898 pointed out that Milde had been "followed more or less implicitly by English and American botanists" in confusing the American species with *B. ternatum* of Japan and continental Asia. It was stated by Underwood that "No one, who holds any modern view of species, who has seen genuine specimens of *B. ternatum* from Japan, could hold for a minute that it was the same as the various species that occur in North America, and would adopt at once Prantl's masterly definition of this thin-leaved species with such a natural geographic range." Since Underwood's treatment of this group of grapeferns, the name *B. ternatum* has been confined to plants of Asia—Japan, China, and India—and the species has not been acknowledged to occur in the New World. My own studies, however, indicate that *B. ternatum* or a plant closely related to it *does* occur in North America, and, in fact, possesses a rather wide range. I fail to find that this plant, whatever its ultimate identity will prove to be, has been treated in the literature, and

[1] Research supported by a grant from the H. H. Rackham School, University of Michigan.

[2] Torrey Bot. Club Bull. 25 (no. 10): 521–634.

[Volume 49, Number 2, of the JOURNAL, pp. 65–96, was issued July 7, 1959.]

"Botrychium ternatum," leaf type extremes from one locality, Ida Twp., Monroe Co., Mich., Wagner 8670.

it is hoped that this discussion will call attention to its peculiarities.

During the course of field studies of the evergreen grapeferns of Michigan covering the past seven years, I had occasionally met a rather finely divided plant of distinctive appearance, which did not conform with any of the more common species with which it grew, namely *B. dissectum* or any of its diverse forms, *B. multifidum*, or *B. oneidense*. I had usually considered this plant to be perhaps a diseased or otherwise abnormal variant, until in the fall of 1958 I encountered, for the first time, a truly sizeable population. Later field investigations have proved that the unusual plant is widespread in Michigan; and preliminary herbarium observations show that it ranges over a large area of the northern states. The field work is continuing at the present time. The report to be given here is intended to call the attention of other botanists to the existence of this plant, in the hope that we may be able to determine the full extent of its range.

Comparison of the odd plant with materials in the American Fern Society Herbarium and in the Edwin B. Copeland Herbarium show that it cannot be distinguished on any characters as yet known to me from the true *B. ternatum* of Asia. This species is readily distinguished in the living state from the other species of *Botrychium* with which it grows, but it is somewhat less easy to identify in the dried state. The plant has unquestionably been overlooked in many areas, as it was in Michigan, and I believe that these notes should be of help to others. I hope to make a much more detailed report on this plant in relation to its immediate relatives in the near future.

Before presenting notes on the occurrence and distinguishing features of the American plant resembling *Botrychium ternatum*, I should like to emphasize sev-

eral points. The first is that, in studying the evergreen grapeferns, it is essential to obtain a sample comprising a number of specimens if possible. As I have pointed out elsewhere, our experience shows that there is no need to worry about destroying a colony if the collector is careful to remove leaves *above* the base of the petiole. The second is that grapeferns of this group are extremely variable according to habitat and, also, to age of plant. In the open, dry habitats, such as grassy, upland fields, a species will have an entirely different aspect (segments broader, approximate or overlapping; texture thick; the fertile "panicle" disproportionately large and much branched) from those in deeply shaded, moist habitats (the segments narrower, remote; texture thin and membranous; fertile "panicle" narrow or absent).

Very young specimens do not necessarily lack fertile structures. Under certain conditions, in fact, tiny plants only a few inches tall may produce the fertile "panicles," and these plants have a striking appearance, wholly distinct from the normal, much larger form of the species. The differences between single individuals of *Botrychium* are often so subtle that careless pressing makes a plant, which was well marked in the growing state, barely recognizable on the herbarium sheet without removal and treatment. If a specimen is taken in July or August (at least under the conditions of the Great Lakes area) it will appear more or less membranous when pressed; if taken in the fall, winter, or spring, it will be more leathery and opaque when pressed. As an illustration of some of our difficulties, one of the problems that has faced us in our study is the commonly repeated statement that the species *Botrychium oneidense* (also treated as a variety or form of *B. dissectum* or *B. multifidum*) is "thin-textured." Actually, when *B. oneidense* is found growing with *B. dissectum*, *B. multifidum*, and "*B. ternatum*" in the same

microhabitat, we have found it consistently to be more leathery than any of the others.

Some fifty localities having various combinations of *Botrychium dissectum*, *B. multifidum*, *B. oneidense*, and (or) "*B. ternatum*" have now been studied in Michigan and nearby Ohio in connection with the present project. Mr. Dale J. Hagenah of the Cranbrook Institute of Science and Mr. Robert F. Blasdell of the University of Michigan have been especially helpful in this survey. Seventeen of these localities we have found have yielded "*B. ternatum*," in number per locality from one individual to well over a hundred. In terms of frequency of association with "*B. ternatum*." *B. dissectum* is the first (all localities where *B. ternatum* has been found to date have *B. dissectum* also); *B. oneidense* next (seven localities); and *B. multifidum* last (five localities). All four species occur together in a few localities.

Herbarium specimens graciously lent by Professor Hugh Iltis from the University of Wisconsin Herbarium demonstrate that at least some of the specimens labeled as *B. multifidum* f. *dentatum* R. Tryon conform to the characters of the plant we are here calling *B. ternatum*. Specimens in other herbaria indicate that "*B. ternatum*" occurs also in Iowa, Indiana, New York, Vermont, and parts of Canada. The fern known as *Botrychium ternatum* subsp. *robustum* (Ruprecht) Komorov, which occurs in Kamtschatka (N.E. Soviet Russia), Unalaska (Aleutians, S.W. Alaska), and elsewhere, including northern Japan, is evidently the northern representative of *B. ternatum*, and may be more or less matched in segment shape by more southerly specimens taken in exposed fields. The Mexican *B. schaffneri* seems also to be closely related.

As indicated above, recognition of "*B. ternatum*" in the field is somewhat easier than in the herbarium. The segments of "*B. ternatum*" are all roughly of the same

size, lacking the tendency for a non-pinnate terminal part of the segment found in *B. dissectum* and, to a somewhat lesser extent, *B. oneidense*. The segments of "*B. ternatum*" are decidedly *denticulate*, *angular*, and usually *strongly pointed;* otherwise, the leaf plan is approximately like that of *B. multifidum* which grows with it, except that the leaves of the latter species tend to be larger and more leathery. The most "multifidum-like" form of the plant in question is shown in the upper right hand corner of the plate. Seen at full size, however, the segment outlines, segment margins, and textural characters of this specimen are like "*B. ternatum.*" The whole plant of "*B. ternatum*" is usually lax, and a little smaller and decidedly more slender than *B. dissectum*, *B. oneidense*, or *B. multifidum* as found growing with it in the same spot. Giant specimens of "*B. ternatum*" are occasionally discovered, as shown by the middle specimen in the lower row of the plate.

A most useful field character of "*Botrychium ternatum*" involves the slight but definite curling of the pinnules, which are convex above and concave as viewed below. The ultimate segments have this peculiarity more or less in all specimens, so that they have a somewhat "diseased" appearance. The concavity of the segments is especially well shown when the leaf blade is viewed from below. None of the other three species show this feature.

The following key will aid in the identification of average or moderate-sized individuals of the four basic species of evergreen grapeferns in the Great Lakes area:

1. Pinnae divided into true pinnules only basally, the distal one-third or one-fourth of the pinnae usually more or less elongate and not divided into true pinnules.
   a. Segments numerous, usually pointed at tips, the laminar margins extremely variable, finely denticulate to very deeply and coarsely lacerate; leaves mostly turning bronze when exposed to sunlight during winter; habitats diverse.

B. dissectum

a. Segments few, usually more or less rounded at tips; laminar margins practically uniform, entire to denticulate; leaves mostly green when exposed to sunlight during winter; habitats in acid, low woodlands ..... ***B. oneidense***

1. Pinnae divided more or less equally throughout, the distal one-third or one-fourth of the pinnae symmetrically divided into pinnules.

b. Segments rounded to rounded-angulate, blunt, usually entire or nearly so, plane in the living state; plant robust and large ..... ***B. multifidum***

b. Segments sharply angular, pointed, shallowly or deeply denticulate, concave in the living state; plant usually slender and smaller ..... *"B. ternatum"*

In our experience the best habitats for *"Botrychium ternatum"* are discovered by first locating *B. dissectum*, *B. multifidum*, and (or) *B. oneidense*—but the locality should be, above all, in sandy soils. Brushy fields, edges of woods, and old trails in grassy or sedgy, disturbed or formerly grazed sites in swamp woods, or along wooded streambanks—the usual evergreen grapefern sites—are suitable, but sandy, acid soil characterizes most of the habitats we have found for *"B. ternatum."* Careful and organized searching in the appropriate habitats in southern Michigan has been very rewarding, and almost always at least one or a few specimens of *"B. ternatum"* have turned up, growing with one or more of the related species. The largest population of this plant observed in a single locality was well over 150 (near Petersburg, Monroe County, Mich., associated with *B. dissectum* and *B. multifidum*). The average colony, however, numbers around twenty to thirty plants, usually intimately associated with much more numerous *B. dissectum*. No pure populations of *"B. ternatum"* have yet been found in Michigan, although they are being sought.

It is strongly hoped that these notes and figures will serve to stimulate field collectors to pay special attention to populations of the evergreen grapeferns, so that we may increase our knowledge of this long overlooked, and misunderstood, American plant.

Cytotaxonomic Studies of Some American Species of Dryopteris[1]

S. WALKER

The genus *Dryopteris* in America is well known for the difficulties which it presents to the systematist; several of its taxa are classified differently by different authors and hybridization between species is common. Spore morphology in *Dryopteris* has been shown by Crane (1953, 1955, 1956) to be a most useful taxonomic character in helping to separate some of the species.

For the past few years I have been engaged in cytological studies and experimental hybridization within the genus, involving both European and American material, in order to study the evolutionary processes and attempt to elucidate some of the taxonomic problems. The knowledge gained from an investigation of the *Dryopteris spinulosa* complex in Europe has already been published (Walker, 1955); stated briefly, this shows that in Europe there are three allotetraploid species, *D. cristata* (L.) A. Gray, *D. spinulosa* (O. F. Muell) Watt and *D. dilatata* (Hoffm.) A. Gray, together with two diploid forms of "*D. dilatata*," one found in Britain and on the continent of Europe, the other in Madeira. These two diploids are very different in their division of the blades and in spore size, but studies of meiosis in experimental hybrids indicate that they are descendants of the same ancestral diploid, that which is common and part parental to both *D. spinulosa* and *D. dilatata*.

A detailed report on the results obtained from a study of North American material of *Dryopteris* is in preparation for publication elsewhere, but perhaps the following will be of general interest to readers who have met with the taxonomic problems in this genus.

Cytological investigation of *D. cristata* and *D. spinulosa* (typical) from the eastern United States shows that

[1] Presented at American Fern Society Meeting, Storrs, Conn., August, 1956.

Fig. 1 (upper left): Dryopteris "dilatata," Northwestern America; Fig. 2 (upper right): D. "dilatata," Europe; Fig. 3 (lower left): D. intermedia; Fig. 4 (lower right): D. "dilatata," Madeira. All ca. 1/5 natural size

these species are tetraploid ($2n = 164$), as in Europe, but the so-called "*D. dilatata*" from the northwestern states and Canada is diploid ($2n = 82$). *Dryopteris intermedia* (Muhl.) A. Gray from the eastern states is also diploid. Morphological comparisons between the two American diploids and the diploid forms of "*D. dilatata*" from Europe and Madeira show striking similarities. Using pinnation and spores as characters, the northwestern American diploid agrees morphologically with the British and European diploid, whilst *D. intermedia* agrees with the diploid form found in Madeira. Reference to *Figs. 1* to *4* will illustrate the similarity in pinnation of the respective diploids. Cytological results from hybridization experiments support these comparisons.

Dryopteris campyloptera (Kunze) Clarkson is tetraploid and in its morphology is more closely related to the European tetraploid *D. dilatata* than any other form. The presence of glands on the indusium and darker colouration at the base of the scales on the stipe are diagnostic characters or *D. dilatata*. Hybrids involving *D. campyloptera* as a parent have not been available yet for cytological study. (I should be very grateful to anyone who may find it possible to send such material.)

The data given so far correspond closely with those for Europe but there are a number of other related species present in North America which add further complexity since interspecific hybridization is common. Two such recognized species, *D. marginalis* (L.) A. Gray and *D. Goldiana* (Hooker) A. Gray, are both diploid. A number of hybrids have been recognized on morphological grounds and these have now been confirmed cytologically by chromosome studies which support the considered parentage. Examples of these are:

D. cristata × *D. spinulosa* (typical)
Tetraploid ($2n = 164$)

D. × *Boottii* (*D. cristata* × *D. intermedia*)
Triploid ($2n = 123$)

Fig. 5 (left): Dryopteris ludoviciana; Fig. 6 (centre): D. cristata; Fig. 7 (right): D. Clintoniana. All ca. 1/5 natural size

D. × *"fructuosa"* (*D. spinulosa* × *D. intermedia*)
Triploid ($2n = 123$)
D. × *Slossonae* (*D. cristata* × *D. marginalis*)
Triploid ($2n = 123$)
D. intermedia × *D. marginalis* Diploid ($2n = 82$)

Of special interest are *D. ludoviciana* (Kunze) Small and *D. Clintoniana* (D. C. Eaton) Dowell, both of which have at times been regarded as varieties of *D. cristata* but are undoubtedly true breeding species. Whereas *D. cristata* is tetraploid, *D. ludoviciana* is found to be diploid and differs therefore both cytologically and morphologically from *D. cristata* since it can be distinguished readily by the dimorphism of its sporophylls (See *Figs. 5* and *6*). Genuine *Clintoniana* (*Fig. 7*) is, however, a hexaploid ($2n = 246$) with morphological characters which are intermediate between *D. cristata* and *D. Goldiana;* cytological evidence leaves little doubt that it has arisen as a fertile allopolyploid between these two species. The southern *D. Clintoniana* var. *australis* Wherry is still under investigation but cytological evidence obtained so far indicates that it is a triploid hybrid and not directly related to the northern *D. Clintoniana.* The sporophyll dimorphism shown by var. *australis* suggests strongly that *D. ludoviciana* is part parental to it.

The taxon given the name *D. Leedsii* Wherry is recognized as being intermediate in its morphology between *D. marginalis* and *D. Goldiana.* I am told that this fern can be found in large quantities in particular localities; this would not be expected for a hybrid plant unless fertile. It is therefore of particular interest to find that amongst the plants sent to me as representative of *D. Leedsii*, some are diploid hybrids with abortive spores and others are fertile tetraploids. The similarity in the morphology of the diploids and tetraploids (*Figs. 8* and *9*) is such that once again allopolyploidy is suspected and the putative parents, *D. marginalis* and *D. Goldiana*,

FIG. 10 (LEFT): DRYOPTERIS CELSA; FIG. 11 (RIGHT): D. X SEPA-D. "LEEDSII," DIPLOID. BOTH CA. 1/5 NATURAL SIZE

known. A simple way to distinguish the diploid hybrid from the fertile tetraploid is to look at the type of spore production, abortive or normal.

Perhaps the most controversial taxon is *D. celsa* (Palmer) Small (*Fig. 10*). From several accounts this name is often applied to a variety of plants in the field which are difficult to identify but have characters somewhat intermediate between *D. Goldiana* and *D. Clintoniana*. For this reason it has been looked upon as a hybrid but genuine *D. celsa* is a fertile tetraploid. It is extremely likely that plants often identified as *D. celsa* are not in fact correctly named. Further investigation of this *D. celsa* complex is being made. Although *D. Goldiana* is almost certainly one of the parents, *D. Clintoniana*, from cytological evidence, could not be the other.

D. separabilis Small (*Fig. 11*) is considered by most authors to be the hybrid between *D. Goldiana* and *D. intermedia*, both of which are diploid. Cytological investigation of a number of specimens certainly show its hybridity but it cannot have the considered parentage since it is triploid. I believe that it may well be the hybrid between *D. celsa* and *D. intermedia*, which are tetraploid and diploid respectively, as this would account for its chromosome complement and also for its morphology.

A list of the taxa which have been discussed is given in Table I. An attempt to confirm the species and hybrid relationships put forward above can only be made by a program of hybrid syntheses and subsequent cytological study. This is already in progress but results are unavoidably slow and may not be known for a few years. From what has already been said, however, it is evident that the nomenclature and status of various taxa in this genus will require revision; this will be considered when the more detailed results have been published.

Fig. 10 (left): Dryopteris celsa; Fig. 11 (right): D. x separabilis. Both ca. 1/5 natural size

TABLE I

LIST OF SPECIES AND HYBRIDS MENTIONED

Species		Hybrids	
Name	Ploidy	Name	Ploidy
"D. dilatata"	2x	D. intermedia × D. marginalis	2x
D. intermedia	2x	"D. Leedsii" (D. goldiana × D. marginalis)	2x
D. Goldiana	2x	D. × Boottii (D. cristata × D. intermedia)	3x
D. marginalis	2x	D. Clintoniana var. australis	3x
D. ludoviciana	2x	D. × "fructuosa" (D. intermedia × D. spinulosa (typ.)	3x
D. campyloptera	4x	D. × separabilis (? D. celsa × D. intermedia)	3x
D. celsa	4x	D. × Slossonae (D. cristata × D. marginalis)	3x
D. cristata	4x	D. cristata × D. spinulosa (typ.)	4x
"D. Leedsii"	4x		
D. spinulosa (typical)	4x		
D. Clintoniana	6x		

This investigation could not have been carried out without so many willing collaborators in the United States and Canada, who, during the past few years, have sent living plants to me for study. My sincere thanks are due to each one of them and in particular to Dr. E. T. Wherry and Mrs. F. W. Crane who collected, or accepted and despatched a large amount of material on my behalf.

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Some New Combinations in Thelypteris

C. V. MORTON

As recently pointed out in this Journal,[1] the genus *Cyclosorus* Link can hardly be considered distinct from *Thelypteris* Schmidel. Most of the species have received names under the old inclusive genus *Dryopteris*, but not many have as yet been transferred to *Thelypteris* formally. The following are a few of the more common species for which names have been needed for reports of identifications.

THELYPTERIS **arida** (D. Don) Morton, *comb nov.*
Aspidium aridum D. Don, Prodr. Fl. Nepal. 4. 1825.
Dryopteris arida O. Kuntze, Rev. Gen. Plant. **2**: 812. 1891.
Cyclosorus aridus Ching, Bull. Fan Mem. Inst. Biol., Bot. Ser. **8**: 194. 1938.

THELYPTERIS **extensa** (Blume) Morton, *comb. nov.*
Aspidium extensum Blume, Enum. Pl. Jav. 156. 1828.
Dryopteris extensa O. Kuntze, Rev. Gen. Plant. **2**: 812. 1891.
Cyclosorus extensus Ching, Bull. Fan Mem. Inst. Biol. Bot. Ser. **8**: 182. 1938.

THELYPTERIS **heterocarpa** (Blume) Morton, *comb. nov.*
Aspidium heterocarpum Blume, Enum. Pl. Jav. 155. 1828.
Dryopteris heterocarpa O. Kuntze, Rev. Gen. Plant. **2**: 813. 1891.
Cyclosorus heterocarpus Ching, Bull. Fan Mem. Inst. Biol., Bot. Ser. **8**: 180. 1938.

THELYPTERIS **unita** (L.) Morton, *comb. nov.*
Polypodium unitum L. Syst. Nat. ed. 10. **2**: 1326. 1759.
Dryopteris unita O. Kuntze, Rev. Gen. Plant. **2**: 811. 1891.
Cyclosorus unitus Ching, Bull. Fan Mem. Inst. Biol., Bot. Ser. **8**: 192. 1938.

THELYPTERIS **multilineata** (Wallich ex Hook.) Morton, *comb. nov.*
Polypodium multilineatum Wallich ex Hook. Sp. Fil. **5**: 11. 186. 1864.
Dryopteris moulmeinensis (Beddome) C. Chr., Ind. Fil. 278. 1905.
Abacopteris multilineata Ching, Bull. Fan Mem. Inst. Biol., Bot. Ser. **8**: 253. 1938 [*"multilineatum"*].

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[1] This JOURNAL **48**: 140, 141. 1958.

As pointed out by Holttum,[2] the genus *Abacopteris* is scarcely distinguishable from *Cyclosorus*, and thus must also be now referred to *Thelypteris*.

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Ferns and Los Angeles Smog

R. C. BENEDICT

Los Angeles "smog" is merely a specially well-known example of the unpleasant and harmful results of urban and industrial activities. Recently, a scientific study of its effects on plant life has begun. Dr. Ruth Ann Bobrov Glater has reported on damage to fern leaves in the article "Smog Damage to Ferns in the Los Angeles Area."[1] Since this is a matter of importance to fern gardeners, we quote below some of the remarks from Dr. Glater's paper.

"Smog" is "a complex of liquids, solids, and gases, comprising more than 50 chemical elements and compounds, and producing, among other effects, low visibility, eye irritation, crop damage, excessive rubber cracking, and odor nuisances. Plant damage is considered to be due to certain intermediate peroxidic products resulting from the chemical combination of unsaturated hydrocarbons with the ozone of the atmosphere. Certain species of vegetables, ornamentals, and weeds were found to be singularly sensitive to smog. . . .

"Recently, a new symptom was observed in ferns in response to the polluted air of Los Angeles. In the field as well as under lath, fern leaves showed characteristic markings following a period of high smog intensity. The gross symptoms were quite distinct from those previously reported on other plants. Damage manifested itself as

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[2] Ferns of Malaya 285. 1954.

[1] Phytopathology 46: 696–698. *figs. 1–5.* 1956.

a tan spotting of leaflets, followed by local or general dehydration of affected areas, ending in complete necrosis of the entire leaf.''

The species specially studied (and illustrated) by Dr. Glater were *Microlepia platyphylla* (abundant in the Fern Dell in Griffith Park) and *Blechnum* (*Lomaria*) *gibbum* (less common).

''Approximately 24 hours following the incidence of smog, tan lesions, commonly near the smaller veins, appear on the leaflets. At this time, damage to the cells directly above the stomata can be seen with a microscope. Since the spongy mesophyll is a very loose tissue, the smog-laden air easily penetrates through the entire leaf. Within 48 hours, part or all of a damaged frond may become completely dehydrated, turn brown and brittle, and crumble on pressure. . . . An entire frond or isolated portion of individual fronds on a given plant may be damaged. Old, middle-aged, and young leaves appear to be equally sensitive. The growing tip of the plant, with its spirally uncoiling developing leaves, usually is not damaged. Occasionally, following a long and severe smog period, a young plant may be completely killed, growing point and all. More commonly the plant will continue growth, albeit slowly. Stems, roots, and all vascular elements of the plant remain uninjured.

''The general response of the cells of fern leaves to smog is similar to that described in other plants, but differs in two ways: 1) in the random distribution of damaged markings as contrasted with the restricted smog damage pattern observed in other plants and 2) in the extreme sensitivity of the plant, a condition that results in complete necrosis of many leaves. The specific expression of damage in ferns may be attributable to the extreme sponginess of the laminal tissue, through which polluted air can move easily and rapidly, and to the weak suberization of cell walls.''

Ferns in Cultivation, I

SYLVIA LEATHERMAN

Many people have difficulty growing ferns in clay pots, especially as house plants or in areas with hot summer temperatures. Upon tapping a fern out of a pot to shift it to the next size pot study the root formation. The roots twine and wrap themselves next to the inside wall of the pot. The clay pot is porous, the main reason for the use of a clay pot, and being porous the pot becomes dry and in turn the roots suffer from this dry condition.

The double pot method, which I have recommended to many people who are now growing potted ferns successfully, is an ideal way to grow your ferns under adverse conditions. A clay pot about four inches larger in diameter than the potted fern is used. In the bottom of this pot place a piece of crockery over the drainage hole. On top of this fill in with charcoal and pea gravel, using enough material so when you place your potted fern in this pot the tops of the two pots are level. Fill in the space between the two pots with sphagnum moss or peat moss.

The inner pot, the one where your fern is growing, will then remain damp and cool and this is beneficial to your fern as ferns love to grow where their root system is kept cool and moist. Ferns will not tolerate dry roots. Some people have reasoned, and wrongly, that to overcome this condition of the roots, they could plant their fern in a glazed pot. Porous pots, for numerous reasons, should be used. Would you want your feet encased in a container which received no air and became stagnant?

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Recent Field Notes

THOMAS DARLING, JR.

ASPLENIUM TRUDELLII IN WEST VIRGINIA

On August 24, 1958, Dr. James W. Johnston, Jr., of Georgetown University, and I drove to Trout Pond, in the George Washington National Forest, Hardy County, south of Wardensville, the only natural lake (really just a pond) in West Virginia. On a pinnacle-like cliff in the vicinity we found quite a number of plants of the interesting rock-fern hybrid *Asplenium Trudellii* (*A. montanum* × *pinnatifidum*) along with both parents. The specimens of the hybrid were relatively small compared with the luxuriant plants I have seen west of Wardensville and near French Creek, West Virginia. In the latter localities fronds occasionally attain a length of eight inches or more. All three of these stations for *A. Trudellii* are known to local botanists.

DRYOPTERIS FRAGRANS AND WOODSIA GLABELLA IN THE CATSKILLS

Back in 1940 Edward M. Shields, of Haines Falls, New York, discovered three rarities in the Catskill Mountains which had previously only been found many miles to the north. He published an account of his discoveries in an article in the *Fern Journal* entitled "Porcupines and Ferns."[1] These unusual ferns were *Dryopteris fragrans* (Fragrant Fern), *Woodsia glabella* (Smooth Woodsia), and *Woodsia alpina* (Alpine Woodsia).

When I visited Mr. Shields at his summer home in the Catskills in the summer of 1958, we revisited the native haunts of two of these rare ferns. On June 30th, we explored the cliffs where *D. fragrans* had been found

[1] This JOURNAL **33**: 57–59. 1943.

at the southern limit of its range. As related by Mr. Shields in the 1943 Journal, "It will always be a matter of utter amazement to me that these stations on the ramparts of the Hudson, almost within sight of the city of New York, had not before been reported." He continues by saying that literally hundreds of these ferns were to be found on the cliffs. Now, nearly twenty years later, the same "status quo" prevails. If anything, the plants are even more numerous than before. The treacherous terrain, with its high inaccessible cliffs and breathtaking views over the surrounding countryside, is not attractive to vandals bent on the destruction of this rarity.

The next day, July first, we explored the area where *Woodsia glabella* had been found. Here the situation was reversed. Painstaking search resulted in the discovery of only two small plants, where previously many more had been in evidence. Whether due to adverse weather conditions or over-collection, this graceful and attractive fern appears doomed to extinction in this locality.

My host informed me that *Woodsia alpina*, although extremely scarce, was to be seen in the mountains some distance away. Unfortunately, lack of time prevented my making this interesting trip.

ASPLENIUM BRADLEYI IN PENNSYLVANIA

The rare fern *Asplenium Bradleyi* was once luxuriant and plentiful in certain ravines along the lower Susquehanna River in Lancaster and York Counties, Pennsylvania. This was the situation encountered by the late John K. Small in 1890 while he was still a student at Franklin and Marshall College, Lancaster, Pennsylvania. Many beautiful specimens were collected by him and deposited in various herbaria during those early days. Then, following a long period of extreme drought,

the blasting away of cliffs to permit railroad relocations, and over-collection by thoughtless individuals, *A. Bradleyi* almost totally disappeared from the scene. In the years between 1937 and 1941, when I spent considerable time searching the area, this fern was known to local collectors and others at only one location, near Marietta, where I found it to grow sparingly.

Looking through the old Fern Journals, I was interested to note in Volume I (1911) an article by Harold W. Pretz of Allentown, Pennsylvania, entitled "An Interesting Find." It described the discovery of *A. Bradleyi* on the high cliffs overlooking the Lehigh River near Glen Onoko, Carbon County, Pennsylvania.[2] There are only two records of this species having been collected farther north, in the state of New York.

On October 21, 1956, after consulting Mr. Pretz as to the approximate location, C. V. Morton and I carefully explored the same cliffs where this rarity had been discovered 45 years previously, but to no avail. Either the fern was overlooked, or it had disappeared due to unfavorable climatic conditions.

While visiting Mr. Shields in the Catskills, I learned that he had discovered a small colony of *A. Bradleyi* in October, 1942, in Muddy Run Ravine, Lancaster County, Pennsylvania. He told me that it was located "possibly a quarter of a mile from the railroad tracks, about three-fourths the way up the slope, and on a large boulder rather than a cliff."

Although it was much like looking for a needle in a haystack, on October 19, 1958, sixteen years after the reported discovery, I found my way into this ravine and began a methodical search. Since I could not locate the large boulder after several hours' search, the trip seemed destined to failure. Before giving up, however,

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[2] This JOURNAL 1: 137–141. 1911.

I climbed to the very summit of the slope and examined the perpendicular rock ledges in this area. Here, much to my satisfaction, I finally succeeded in finding plants of *A. Bradleyi* at scattered intervals. They were not large, but appeared luxuriant. It is to be hoped that this rare species is staging a comeback in this locality. Although *A. pinnatifidum* was also found in these cliffs, there was no sign of the hybrid, *A. Gravesii.*

DRYOPTERIS LEEDSII IN MARYLAND

In 1931 the late Arthur N. Leeds discovered a colony of the woodfern hybrid *Dryopteris Goldiana* × *D. marginalis* on the bank of the Susquehanna River, below the Conowingo Dam in Harford County, Maryland. Ten years later Dr. Wherry visited the locality, noted at least 200 individual plants of all sizes, and suggested the name "*D. Leedsii*" in an article entitled, "A Woodfern Hybrid Deserves a Name."[3]

On October 18, 1958, I visited this colony and found a number of plants of the hybrid in a limited space of time. One specimen was larger than the maximum height of 150 cm. previously recorded by Dr. Wherry. The clump was at least six feet tall, though at this season of the year most of the fronds were prostrate. Although one of the parent plants (*D. marginalis*) is present in this locality, the other (*D. Goldiana*) is totally absent. Dr. Wherry's theory is that the spores of *D. Goldiana* were blown there from some distance away, and germinated to form prothallia which yielded sperms to fertilize some *D. marginalis,* but since the habitat is not suitable to the former, the *Goldiana* gametophytes never developed into sporophytes of that species itself. The nearest colony of *D. Goldiana* known in recent years is on a farm about two miles to the northwest.

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[3] Bartonia 21: 1, 2. 1942.

FUTILE SEARCH FOR ASPLENIUM KENTUCKIENSE AND A. STOTLERI IN WEST VIRGINIA

On October 5, 1957, accompanied by Dr. James W. Johnston, Jr., I journeyed to the cliffs of the Shenandoah River, east of Charles Town in Jefferson County, West Virginia, in an effort to discover the rare rock-fern hybrid *A. kentuckiense*, a cross between *A. platyneuron* and *A. pinnatifidum*.[4]

Since these cliffs extend for several miles along the east side of the river, we chose to concentrate our search in a limited area near the dam. Although we found *A. platyneuron* common throughout, along with scattered *A. pinnatifidum*, there was no sign of the hybrid.

On July 20, 1958, I explored the area south of the dam to a point opposite the south end of Snyder Hill, again with no success. Here *A. pinnatifidum* is locally plentiful in spots, with *A. platyneuron* abundant everywhere. It would be difficult to imagine a more likely place for *A. kentuckiense*. On some ledges both parent plants grew out of the same crevice. The hybrid, however, seems to be extremely rare, even in favorable localities. I have made many trips to the Maryland Heights area across the Potomac from Harpers Ferry and to the nearby Weverton cliffs, where both parents grow in close proximity, but have failed to uncover the hybrid.

Having found this fern so difficult to locate in its native habitat, I have repeatedly attempted to raise it artificially from spores of the parent plants as I succeeded in doing with *A. Gravesii*,[5] but I have not been successful as yet.

On October 26, 1958, accompanied by Dr. Johnston and James E. Benedict, I again visited the Jefferson County cliffs. This time the object of our search was

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[4] This JOURNAL 26: 104, 105. 1936; 48: 39–43. 1958. Evolution 8: 113–116. 1954.

[5] This JOURNAL 47: 55–66. 1957.

A. Stotleri near Keys Ferry at the northern extremity of the high ledges below the dam.[6] This extremely rare Appalachian spleenwort was once believed to be the cross between *A. platyneuron* and *A. pinnatifidum* (now considered *A. kentuckiense*), but a more recent conjecture is that *A. Stotleri* represents the hybrid between *A. pinnatifidum* and *A. trichomanes*.

Following directions given by Dr. Wherry, we found our way to a high ledge opposite the power plant which Mr. Benedict, who had visited the *Stotleri* cliff when the fern was still in evidence, felt positive was the exact spot, but the rarity was not to be seen. *Asplenium Stotleri*, incidentally, has been found only on this single cliff in Jefferson County, West Virginia. Dr. Wherry, after revisiting the locality several years ago, wrote me that he considered the fern essentially extinct. At that time a few sporelings of *A. Stotleri* were to be seen, but were being crowded out by *A. platyneuron*.

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Recent Fern Literature

MEDICINAL FERNS:—In "Medicinal Plants of the Philippines,"[1] a work published some years ago which has just come to our attention, 18 pages are devoted to the pteridophytes. Apparently, many of these plants are well known in the Philippine Islands and in common use. Altogether, 30 species are described and discussed at some length. As is usual in folk medicine, the uses vary from the reasonable, such as infusions used as anthelmintics or astringents, to the fanciful-remedies for tuberculosis, beri-beri or snake-bite.—C. V. MORTON.

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[6] This JOURNAL 19: 135, 136. 1929.

[1] Philippine Dept. of Agric. & Natural Resources Technical Bull. 16. 1951.

THE GENERA OF GLEICHENIACEAE.—A reappraisal of the genera of Gleicheniaceae by Dr. R. E. Holttum deserves careful study; this is contained especially in two recent papers—"On the Taxonomic Subdivision of the Gleicheniaceae, with Descriptions of New Malaysian Species and Varieties,"[1] and "Morphology, Growth-Habit, and Classification in the Family Gleicheniaceae,"[2] in which much of the same material is presented, although from different points of view. In Christensen's Index Filicum, only two genera are recognized—*Stromatopteris* and *Gleichenia*—whereas Copeland, in his Genera Filicum, recognized six, and more recently Nakai tried to recognize even more and to divide the family into two subfamilies. Holttum has shown that the primary character stressed by Nakai, namely trilete versus monolete spores, is unnatural, and that both kinds of spores can occur even within a single species (*Dicranopteris linearis*). He has shown also that one of the genera recognized by Copeland, namely *Platyzoma*, should not be referred to the Gleicheniaceae at all; it apparently finds its closest alliance with the genus *Jamesonia* (of the Polypodiaceae, *s. l.*). The genus *Dicranopteris* differs in several important characters from the others and can conveniently be given generic status. The other genera recognized by Copeland—*Gleichenia*, *Sticherus*, and *Hicriopteris*—are much closer and are best united as subgenera of *Gleichenia*. Holttum shows that the group called "*Hicriopteris*" by Copeland is not properly so called, the type and only original species being a *Dicranopteris*; as a subgenus this group becomes *Diplopterygium*. The name *Sticherus* disappears also, to be replaced as a subgenus by *Mertensia*. Holttum's key will be permanently valuable; it is reproduced below:

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[1] Reinwardtia 4: 257–280. 1957.
[2] Phytomorphology 7: 168–184. 1957.

1. Fronds unbranched (apart from occasional true dichotomy), borne on erect branched stems arising from a creeping rhizome; stellate or branched hairs lacking on vegetative parts of plant; paraphyses in the form of small irregular scales with projecting marginal cells; frond-bearing stems partly covered with non-peltate scales and bearing long simple hairs. Subfamily Stromatopteridoideae: only genus *Stromatopteris*

1. Fronds of fully developed plants branched pseudo-dichotomously (forked), often many times, with dormancy (periodic or permanent) of the apices within the forks; fronds borne directly on a creeping rhizome; stellate or branched hairs, or fringed scales, or both, always present on vegetative part of plant ..... Subfamily Gleichenioideae

2. Hairs stellate with rays consisting of single cells, or simple and very short; scales peltate, with fringe of outgrowths from marginal cells (in *G. laevissima* margins entire); sori of 2–4 large sporangia, with paraphyses; lateral veins in a lobe of the lamina simple or once-forked. ..... *Gleichenia*

3. Ultimate branches pinnate with deeply lobed leaflets.

4. Dormancy confined to a periodic condition of the branch continuing the main rachis of the frond; lobes of lamina each with costule and once-forked lateral veins; sori several on each lobe. *Gleichenia* subg. *Diplopterygium* (*Hicriopteris* of auth.)

4. Dormancy often occurring, and persistent, on other branches of the frond; lobes of lamina each with costule and veinlets all simple; one sorus on a lobe. ..... *Gleichenia* subg. *Gleichenia*

3. Ultimate branches bearing a deeply pinnatifid lamina, its lobes entire or slightly toothed.

Gleichenia subg. *Mertensia* (*Sticherus* Presl).

2. Hairs consisting of a row of cells, with one or more branches at the base and often outgrowths also from other cells; no scales; sori of 8–15 or more sporangia, lacking paraphyses; lateral veins in a lobe of the lamina forked 2–4 times. *Dicranopteris*

5. An accessory branch, of the same form as the ultimate branches, often present on the basiscopic side at the base of each branch from a fork; vascular system of rhizome a protostele ..... *Dicranopteris* subg. *Dicranopteris*

5. Accessory branches lacking; vascular system of rhizome a solenostele ..... *Dicranopteris* subg. *Acropterygium*

The genus *Stromatopteris* is an excessively rare one, confined to the island of New Caledonia. *Gleichenia* subg. *Gleichenia* is strictly Old World, occurring in Africa, Australia, and Malaysia. *Gleichenia* subg. *Diplopterygium* is primarily Old World also, but there is one New World species, *G. Bancroftii*. *Dicranopteris* subg. *Dicranopteris* includes the common Old World species *D. linearis* and its allies, and the widespread American *D. flexuosa*, the Brazilian *D. nervosa*, and three little known South American species *D. rufinervis*, *D. Schomburgkiana*, and *D. seminuda*. The subg. *Acropterygium* includes only the common American species *D. pectinata*. All the other New World species are referable to *Gleichenia* subg. *Mertensia*.

Dr. Holttum is to be congratulated on this work, which constitutes an important advance in our knowledge of this family. He has a better understanding of the genera than Copeland, Ching, or Nakai had, and his results deserve to be widely accepted.—C. V. MORTON.

FERNS OF CHINA:

There is a recent publication (dated 1958) with a title in Chinese that may be translated as Flora of the Northeast Province, I. The chief editor is Liou Tchen-ngo. The "Northeast Province" referred to is that part of China formerly known as Manchuria, or briefly before the last war as Manchukuo. It is situated between Korea on the south and Siberia on the north and east, and is bounded on the west by the Mongolian Republic. This first part of the flora deals with the Pteridophyta. The author is apparently not indicated, but it may well be R. C. Ching, who is again active in botanical work in China; the style of the citations is that of Ching. The treatment is in Chinese throughout, except for the description in an appendix of three new species and one new variety in Latin. However, the Latin names of the

plants enable one to gain an idea of the flora, and some of the species are illustrated by line drawings.

The region is all north of Lat. 40° N., and consequently is in the temperate zone. Quite a number of the species represented are boreal species known from Europe and Siberia, and a good many occur in boreal North America also. Among the familiar names are *Ophioglossum vulgatum, Botrychium Lunaria, B. ramosum* (i.e. *matricarifolium*), *B. multifidum, B. robustum, B. virginianum, Osmunda cinnamomea, O. Claytoniana, Pteridium aquilinum, Adiantum pedatum, Camptosorus sibiricus, Asplenium Ruta-muraria, Athyrium acrostichoides* (*i.e. thelypterioides*), *Athyrium multidentatum* (*A. Filix-femina* var. *multidentatum*), *Cystopteris fragilis, Gymnocarpium Dryopteris, Thelypteris Phegopteris, T. palustris, Matteuccia Struthiopteris, Onoclea sensilis, Woodsia glabella, W. ilvensis, Dryopteris austriaca, D. fragans, Polystichum Braunii, Polypodium virginianum, Marsilea quadrifolia, Salvinia natans, Lycopodium Selago, L. obscurum, L. annotinum, L. alpinum, L. clavatum, Selaginella sibirica* (*rupestris* f. *sibirica* Milde), *Equisetum arvense, E. sylvaticum, E. pratense, E. palustre, E. heleocharis* (*fluviatile*), *E. scirpoides, E. variegatum*, and *E. hyemale*. Thus a visitor from New England should feel quite at home among the ferns of Manchuria. Still, the flora is richer in ferns than New England, and there are a number of more or less unfamiliar plants, such as *Gonocormus* [*Trichomanes*] *minutus, Microlepia pilosella* [doubtless similar in habit to *Dennstaedtia* in the United States], *Davallia Mariesii, Aleuritopteris* [*Cheilanthes*] *argentea, Coniogramme intermedia, Gymnopteris bipinnata, Pleurosoriopsis Makinoi, Cyrtomium falcatum, Phymatodes* [*Polypodium*] *hastata, Pyrrosia* spp., and several unusual-looking species of *Woodsia, Dryopteris*, and *Athyrium*. The novelties (all on p. 69) are *Selaginella tamariscina* var. *ulanchotensis* Ching & Wang-

Wei, *Asplenium conmixum* Ching (an evident error for *commixtum*, which should be corrected), *Athyrium pachyphlebium* C. Chr., and *Dryopteris manshurica* Ching. For the benefit of the many to whom this work will be inaccessible, the original descriptions are reproduced below.

1. *Selaginella tamariscina* (Beauv.) Spr. var. *ulanchotensis* Ching et Wang-Wei var. nov.

A typo differt foliis ovato-lanceolatis angustatis, 1.6–1.9 mm. longis, 0.6–0.8 mm. latis, apice attenuatis aculeatis, margine fere indistincte minutissime serratis, lateralibus et ventralibus directis, vix 2 parallelinervibus.

HABIT. in rupibus.

SPECIMINA EXAMINATA: Mongolia interior Ulanchote. Chang yü-liang et Fuh Pei-yun 479 (Typus).

AREA GEOGR: Mongolia interior Ulanchote. Typus in Inst. Sylv. et pedol. Acad. sinicae Mukden conservatur.

2. *Asplenium conmixum* Ching sp. nov.

Asplenium varians (non Wall) Ogata, le. Fil. Jap. I (1928) *tab. 10.*

Species intermedia inter *A. anogrammoidem* Christ Coreae et *A. variantem* Wall. A prima differt frondibus teneribus, paulo dissectis, colore in sicco viridi, segmentis ultimis latioribus et dentibus obtusis, a secunda foliis magis minoribus textura et dentibus paucioribus obtusisque.

HABIT.: In sylvis, in rupibus.

SPECIMINA EXAMINATA: Prov. 1 Kiang-si Wu-kungshan, Kiangsi expedition No. 1175 (Typus). 2. Prov. Liao-ning Feng-whang-shan leg. G. G. Sato No. 10162; 3. Corea Quelpaert. leg. G. Faurie.

AREA GEOGR.: China centralis et borealis, Korea Japonica. Typus in Inst. Bot. Acad. Sinicae, Peking conservatur.

3. *Athyrium pachyplebium* C. Chr. sp. nov.

A. niponici (Mett) Hance affinis fronde multo ampla, pinnulis lobato-pinnatifidis, textura crassiore, costis pinnarum non nullis pinnulium saepissime plus vel minusve roseolilaceis, marginibus incrassatis, venulis crassis, ad apicem hydathodis incrassatis et supra paginem distinctis, soris prope marginem pinnulium dispositis bene differt (R. C. Ching descripsit).

HABIT.: In sylvis.

SPECIMINA EXAMINATA: Prov. Shan-hsi district Yuanchu Harry Smith No. 6130 (Typus); 2 Prov. Hopei Jeho, district Hsing-lum

leg. T. N. Liou No. 4882 1952. 9. 8. 3. Prov. Liao-ning, Chien-shan, leg. Wang-chan No. 1229 1951. 9. 26.

AREA GEOGR.: China borealis.

4. *Dryopteris manshurica* Ching sp. nov.

Species gregis *D. austriacae* Woynar, differt pinnis lateralibus medialibus multo angustioribus longioribusque, textura foliis tenuiora (herbacea), soris indusiisque minoribus.

HABIT.: In sylvis.

SPECIMINA EXAMINATA: 1. Prov. Heilung-Kiang, district. Shang-chi Mt. Takuokui, leg. Wang kuang-cheng No. 1567 (Typus) 2. ibid. Veiho leg. Wang kuang-cheng No. 1367.

AREA GEOGR.: China boreali-orientalis.

TYPUS in Inst. sylv. et Pedol. Acad. Sinicae Mukden conservatur.

C. V. MORTON
Smithsonian Institution

Our member Barbara Joe Hoshizaki has continued with her "Ferns Cultivated in California,"[1] with an article commenting on the genera *Phyllitis*, *Doodia*, *Pyrrosia*, and *Llavea*. C.V.M.

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[1] Lasca Leaves, 9: 8–14. 1959. Probably obtainable from the Southern California Horticultural Institute, Box 688, Arcadia, California.

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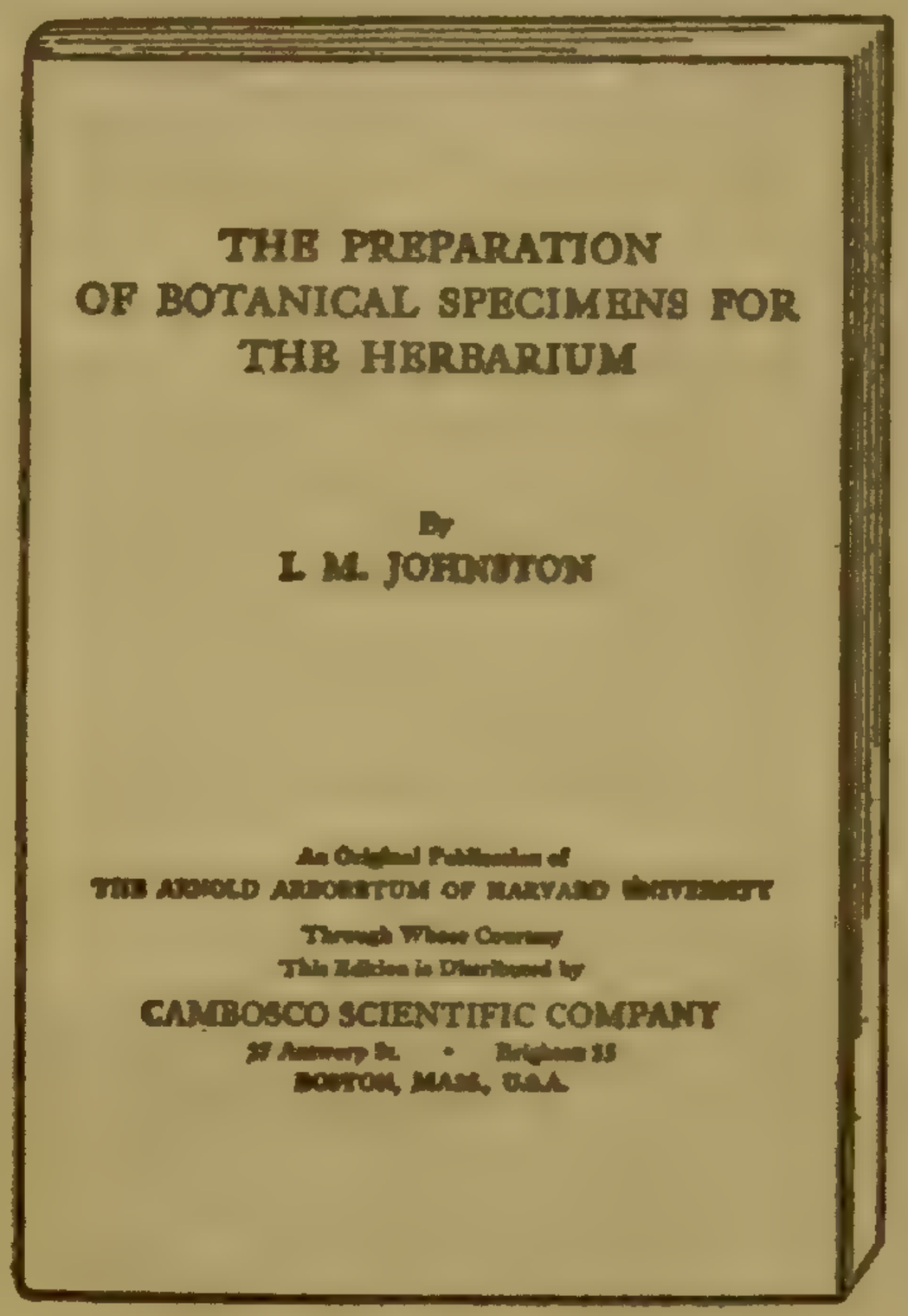

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American Fern Journal

VOL. 49 OCTOBER–DECEMBER, 1959 NO. 4

Observations on Cultivated Ferns: The Hardy Species of Tree Ferns (Dicksonia and Cyatheaceae)

ROLLA TRYON AND ALICE TRYON

The delicate, lacy leaves characteristic of the ferns are most elegantly displayed in the tree ferns, where the stem becomes a trunk and holds them aloft in silhouette. The cultivation of these handsome plants is unfortunately limited to a few areas in the United States that are generally frost-free and cool and moist, or where local niches, ravines, or lath houses can provide these requirements. Most of the species are native to cloud-drenched ravines or highlands in the tropics and subtropics but a few inhabit cooler and drier areas. In subtropical Florida and coastal California from San Francisco to San Diego, where they are cultivated, they are imports from New Zealand, Australia, and a few from Mexico. There remains considerable horticultural potential in the group, which encompasses some 700 or 800 species in six genera or more. The groves in San Francisco's Golden Gate Park are especially notable and probably the most unique display in cultivation. Our interest in tree ferns stems from these. We found a total of 8 species in the park, in several groves of predominantly one or two kinds, and there are records that two others have grown there. In the Los Angeles area we have seen specimens or herbarium records of notable collections at the University of California Botanic Garden, La Fleur Nursery, and in the gardens of Dr. W. C. Drummond

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and Mrs. Fay A. MacFadden, members of the Fern Society. The most complete herbarium collections of cultivated species are in the California Academy of Sciences at San Francisco, the University of California, Los Angeles, and the United States National Herbarium. This study has been made on the hardy tree ferns and we have not considered those grown under glass.

In spite of their distinctive aspect, the tree ferns have not been comprehensively studied and their grouping into genera is a perplexing problem. We have chosen to recognize *Alsophila* and *Hemitelia* in addition to *Cyathea* rather than unite them all under the latter genus as has been done by several recent authors. The nature of the indusium may not be a wholly reliable character nor may it afford the most natural classification. However, until the several hundred species of the family have been adequately studied and a better classification proposed on a sound foundation it seems best not to abandon a character that does have a great deal of utility.

It may be noted here that in several species we have been able to observe both the juvenile and mature plants of the same species and there are some differences in the leaves. The petiole of leaves of young plants may be much longer in proportion to the blade than in old plants and the petiole scales may persist for a longer time. The position of the pinnae, whether plane, somewhat erect or drooping seems to vary both with the age of the plant and the amount of shade it receives. In *Dicksonia fibrosa* and *D. antarctica* the characteristic leaf-cutting may not be found in the young leaves and since there are no differences in indument, it is difficult, if not impossible, to distinguish young individuals. Identification of the tree ferns is most easily done with fertile leaves having the sori mature but not old, thus allowing the indusium to be easily seen. However, we have found many sterile

specimens. We have employed in the key characters of these as much as possible. The best vegetative characters appear to be the indument of the blade, the color and surface of the petiole, and the scales at its base. Since the scales on the petiole are often deciduous or erode with age it is desirable to observe relatively young leaves. Indument such as wax, hairs, or scales is characteristic in most species and although this often requires at least 15× magnification to be clearly seen, the diagnostic value of this indument is well worth the necessary careful observation. In most cases where the hairs or scales are deciduous, they are first lost from the larger axes. Therefore, the rachis of the pinnules and the costae are the best places for the examination of the indument, although a similar type may occur on other axes.

We have been especially helped in the preparation of this paper by Dr. Elizabeth McClintock of the California Academy of Sciences whose interest and enthusiasm for the fine specimens in the Strybing Arboretum and Golden Gate Park lent much encouragement. To Dr. W. C. Drummond and Mrs. Barbara Joe Hoshizaki, who shared much information on the collections in the Los Angeles area, we are grateful. Conrad V. Morton graciously invited us to prepare the study for his series on the cultivated ferns and provided us with extensive loans for study from the U. S. National Herbarium. Dr. Robert C. Cooper of the Auckland Institute and Museum kindly lent specimens of the New Zealand species and has sent us some of the attractive Ponga Ware made from the trunks of *Cyathea*. To Mary D. Tindale we are much indebted for her suggestions on some of the Australian species and especially for her excellent paper on the Australian Cyatheaceae published in the Contributions from the New South Wales National Herbarium.[1]

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[1] 2: 327–361. *pl. 9–15.* 1956.

KEY TO THE HARDY SPECIES OF TREE FERNS

a. Fertile segments with sori borne on the margins, the indusium of two valves; leaves without scales but with hairs, those at the base of the petiole long and prominent. DICKSONIACEAE. b.

b. Inner valve of the indusium membranous, tan to brown, with a thin, usually slightly erose margin, the outer valve herbaceous to coriaceous, wholly green or with a narrow brownish border; sori borne on the lobes of the segments. In the species treated here the blade of the leaf is narrowly oblanceolate (broader in young plants), the pinnae are nearly sessile, and the hairs at the base of the petiole are stiff, harsh to the touch, and do not become matted; the pith of the petiole is rather dry, not mucilaginous. DICKSONIA. c.

c. Petiole and rachis greenish or mottled with brown when fresh, drying to brown; hairs on the under surface of the pinna-rachises whitish to tan. d.

d. Central pinnae about 3 to 4 times as long as broad with the central pinnules having a long-acute to acuminate apex with many (4–8, usually 5–7) simple teeth to a side. ..... *D. antarctica*

d. Central pinnae about 5 to 6 times as long as broad with the central pinnules having a short-acute apex with few (1–4, usually 2 or 3) simple teeth to a side. .. *D. fibrosa*

c. Petiole, at least at the base, and usually also the rachis dark reddish-brown to atropurpureous when fresh or dried; hairs on the under surface of the pinna-rachises reddish-brown to atropurpureous ..... *D. squarrosa*

b. Inner and outer values of the indusium very coriaceous, with the margins entire and thick, whitish to brown; sori borne along the edges of the segments. In the cultivated Hawaiian species the blade of the leaf is broadly ovate, the pinnae are stalked, and the hairs at the base of the petiole are weak, forming a mass soft to the touch, becoming matted with age. CIBOTIUM (This genus is to be treated by another author).

a. Fertile segments with the sori borne between the margin and the costa on the under-surface; leaves, in most of the species including all those treated here, with scales, these especially long and prominent at the base of the petiole, hairs sometimes also present; pith of the petiole mucilaginous. CYATHEACEAE. e.

e. Indusium absent or represented by several appressed, fimbriate scales. ALSOPHILA. f.

f. Leaf tissue coriaceous; blade without small, red squamules. g.

g. Basal portion of the petiole green or partly brownish when fresh, drying to tan or brown, with scales of two different kinds; scales on the under-surface of the pinnule-rachises and costae more or less flat. h.

h. Broad scales at the base of the petiole smoky white, usually with a small brown patch at the very base; scales on the under-surface of the pinnule-rachises and costae usually thickened, tan to yellow or reddish brown, the central portion linear, the margins usually with short spinules of the same color, sometimes with thin, whitish spinules (*Fig. 1*) ..... *A. Cooperi*

h. Broad scales at the base of the petiole light brown to yellowish brown, the basal portion darker; scales on the under-surface of the pinnule-rachises and costae thin, whitish, the central portion ovate to linear, the margins with long, slender spinules, some of them sometimes red (*Fig. 2*) ..... *A. excelsa*

g. Basal portion of the petiole brownish, with nearly uniform brown scales; bullate scales on the under-surface of the pinnule-rachises and costae (*Fig. 3*) *A. australis*

f. Leaf tissue thin-herbaceous; blade with small red, stellate squamules especially evident on the rachises and costae (*Fig. 5*) ..... *A. Colensoi*

e. Indusium present, very thin, cellophane-like to membranous-papyraceous, usually globular, wholly enclosing the young sporangia and later splitting into two to several segments, or saucer-shaped, or hemispherical and partially enclosing the sorus. i.

i. Indusium hemispherical, enclosing only the proximal face of the sorus; rachises with small, red, stellate squamules (as in *Fig.* 5) ..... *Hemitelia Smithii*

i. Indusium globular (or slightly open on the distal face) to saucer-shaped. CYATHEA. j.

j. Pinnules not articulate; petiole smooth to strongly muricate with stout rounded or pointed processes. k.

k. Scales at the base of the petiole of two different kinds; pinna- and pinnule-rachises only scaly beneath, the scales stellate or much dissected. l.

1. Petiole base thick (in large leaves), black, smooth; leaf tissue coriaceous; all scales on the under-surface of the pinnule-rachises and costae whitish, the central portion lustrous, the margins with long spinules, some of them red (*Fig. 7*).
C. medullaris

1. Petiole base slender, dark brown to atropurpureous, muricate; leaf tissue thin-herbaceous; predominant scales on the under-surface of the pinnule-rachises and costae fawn to tan colored, stellate or much dissected, often giving the appearance of a tomentum (*Fig. 8*) .... *C. Cunninghamii*

k. Scales at the base of the petiole uniform; pinna- and pinnule-rachises pubescent beneath, also often with more or less entire, usually bullate scales. m.

m. Blade white-ceraceous beneath; pinnule-rachises yellowish villous beneath, with few or no scales.
C. dealbata

m. Blades green beneath; pinnule-rachises strigose to puberulent beneath, also with bullate scales. n.

n. Pinnules of the longer pinnae 1.5–2.0 cm. broad, those of the upper pinnae about 1.5 cm. broad.
C. fulva

n. Pinnules of the longer pinnae about 1 cm. broad, those of the upper pinnae less than 1 cm. broad.
C. delicatula

j. Pinnules articulate; petiole with sharp spine-like processes; pinnule-rachises sparingly pubescent beneath and with flat, whitish scales with dark marginal spinules (*Fig. 11*) ..... *C. mexicana*

DICKSONIACEAE

DICKSONIA L'HERITIER, SERTUM ANGLICUM 30. 1788

DICKSONIA ANTARCTICA Labill. Nov. Holl. Pl. Spec. **2**: 100, *t. 249*. 1806. Tasmanian Dicksonia.

This species and *D. fibrosa* are not readily distinguished but it seems best to maintain them until a thorough study of the species in their native habitat is made. The characters presented in the key are not always correlated and occasional specimens will be difficult to iden-

tify. Leaves of young plants and small leaves of older ones are usually impossible to determine. However, all of the cultivated material we have examined was easily determined when the specimens were adequate. Splendid plants up to 12 feet in height, having a crown of 25 or more leaves up to 10 feet long, occur in a grove near Rhododendron Dell along the Main Drive in Golden Gate Park. Among a hundred or more specimens in the park we noted a single plant with an offshoot at the base of the trunk.

Native of Australia and Tasmania.

DICKSONIA FIBROSA Colenso, Tasm. Journ. **2**: 179. 1844.

Woolly Tree Fern.

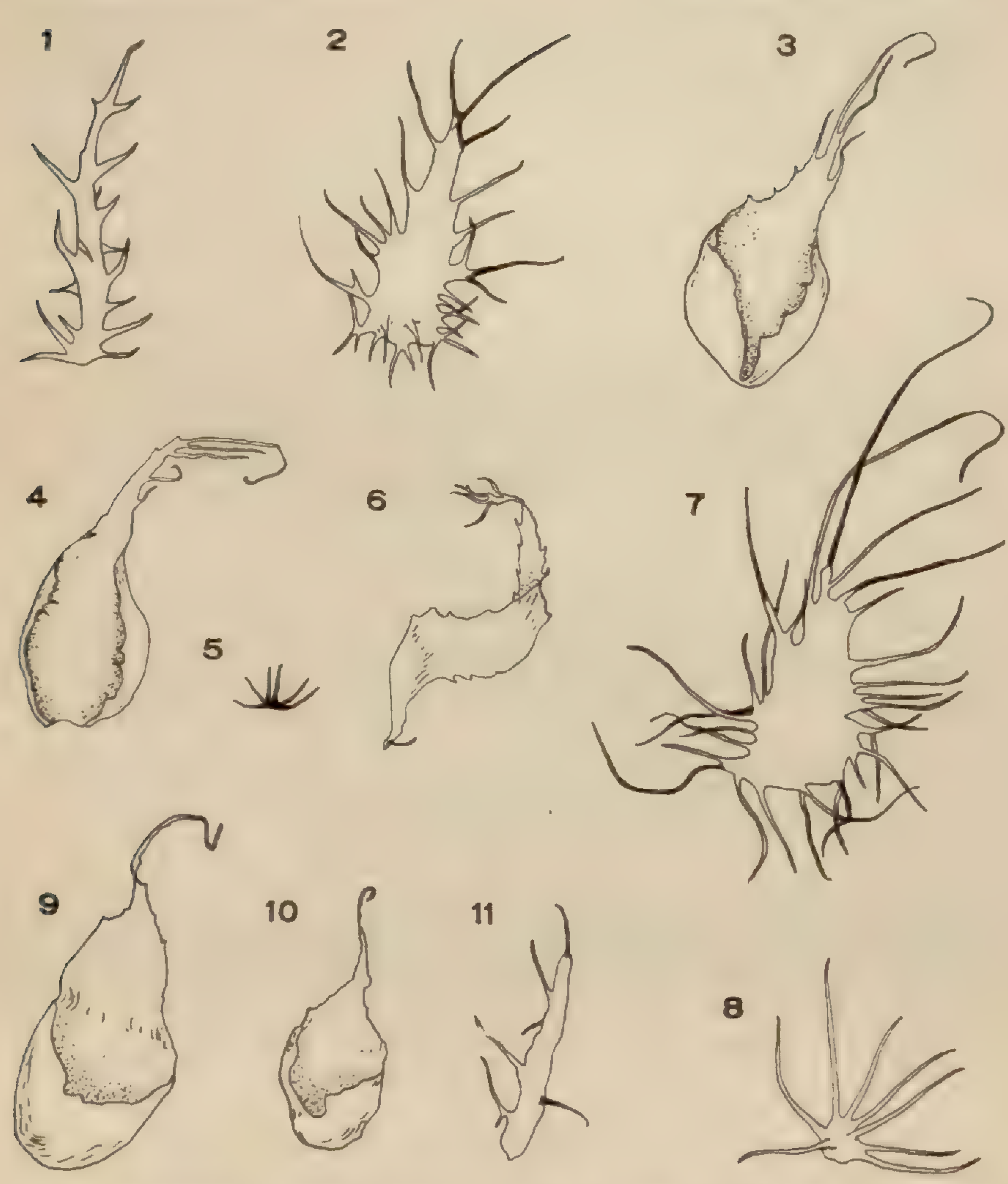
The problem of distinguishing this from the previous species has been discussed. We have observed that in cultivated plants the trunks of *D. fibrosa* are generally shorter (the tallest we have seen was 7 feet) and the leaves are also shorter than those of *D. antarctica*. The two species grow together in Golden Gate Park and there plants of *D. fibrosa* may have somewhat stiffer, more erect fronds.

Native of New Zealand.

DICKSONIA SQUARROSA (Forst.) Swartz in Schrad. Journ. **1800**[2]: 90. 1801. Slender or Rough Tree Fern.

Trichomanes squarrosum Forst. Fl. Ins. Prod. 86. 1786.

The long, appressed, leaf-bases give the slender trunks a unique fluted appearance. The two previous species have relatively stouter, unfluted trunks although the leaf-bases are also persistent. Stolons are reported in native plants of this species but we have not observed them in the cultivated plants; rather, they produce offshoots at or somewhat above the base of the trunk. The



Scales of the Blade of Tree Ferns. Approx. × 30. Fig. 1. Alsophila Cooperi. Fig. 2. A. excelsa. Fig. 3. A. australis. Fig. 4. A. Colensoi. Fig. 5. A. Colensoi. Fig. 6. Hemitelia Smithii. Fig. 7. Cyathea medullaris. Fig. 8. C. Cunninghamii. Fig. 9. C. fulva. Fig. 10. C. delicatula. Fig. 11. C. mexicana.

leaves are often about half as long as those of *D. antarctica* and *D. fibrosa*. There is a handsome grove of these in Delavega Dell in Golden Gate Park with specimens 10 feet tall.

Native of New Zealand.

CYATHEACEAE

ALSOPHILA R. BR. PROD. FL. NOV. HOLL. 158. 1810

ALSOPHILA AUSTRALIS R. Br. Prod. Fl. Nov. Holl. 158. 1810. Australian Tree Fern.

Cyathea australis (R. Br.) Domin, Pterid. 262. 1929.

We do not know of this species cultivated out-of-doors, but it is included because it is commonly confused with *Alsophila Cooperi*. It may be identified by the brownish, muricate petiole-base bearing nearly uniform, bright brown scales, the bullate scales on the under-surface of the pinnule-rachises and costae, and the absence of squamules on the leaves.

Native of Australia and Tasmania.

ALSOPHILA COLENSOI Hook. f. Fl. N. Zeal. **2:** 8, *t. 73.* 1854. Creeping Tree Fern.

Cyathea Colensoi (Hook. f.) Domin, Pterid. 262. 1929.

We have not seen living plants of this species although there are specimens documenting its former occurrence in the Strybing Arboretum and the La Fleur Nursery. Native plants are reported to have prostrate trunks although the apex may be erect and up to 5 feet tall. It resembles *Hemitelia Smithii* in having copious small, red, stellate squamules on the leaves; these are particularly evident on the rachises and costae. The two species are clearly distinct when fertile, for the indusium in *H. Smithii* is conspicuous and hemispherical in form whereas it is absent in *A. Colensoi*. Sterile specimens of *A. Colensoi* may be identified by the following char-

acters: The whitish or tan to light brown scales of the stipe, the bullate or subbullate scales on the pinnule-rachises and costae (*Fig. 4*), and the simple veins of the ultimate segments. *Hemitelia Smithii* is characterized by dark brown stipe scales, flat or twisted scales on the pinnule-rachises and costae (*Fig. 6*), and forked veins of the ultimate segments, at least near the base of the segments.

Native of New Zealand.

ALSOPHILA COOPERI Hook. ex F. Muell. Fragm. Phyt. Aust. **5**: 117. 1866. Cooper's Tree Fern.

Cyathea Cooperi (Hook. ex F. Muell.) Domin, Pterid. 262. 1929.

This is probably the most frequent and successfully cultivated species of the tree ferns. It is grown both in Florida and California where we have seen specimens up to 12 feet tall; it is reported to reach three times that height in Australia. Unfortunately this species has been widely distributed under the name of *A. australis;* probably most of these cultivated specimens are properly referred to *A. Cooperi.* In Los Angeles a vigorous strain of this species grown by Mrs. Fay MacFadden and A. W. Roberts has been descriptively called Robust Tree Fern. The species is closely allied to *A. excelsa;* these two are clearly distinct from other species in having narrow, reddish scales among broader whitish to yellowish brown ones at the base of the petiole. Both kinds of scales have spinescent-serrate margins. Intermediate forms of scales occur. The species are also characterized and particularly distinct from *A. australis* by the early dehiscence of the petioles, which leave clean, oval leaf-scars on the trunk.

Native of Australia.

ALSOPHILA EXCELSA R. Br. ex Endl. Prod. Fl. Norfolk. 16. 1833. Norfolk Island Tree Fern.

Cyathea Brownii Domin, Pterid. 262. 1929, not *Cyathea excelsa* Swartz, 1801.

This species is quite close to *A. Cooperi*. The characters by which we separate the two in the key are largely adapted from the work of Miss Tindale on the Australian Cyatheaceae. It is rare in cultivation and we have seen only two living plants in Golden Gate Park, the largest of which was 22 feet tall.

Native of Norfolk Island.

CYATHEA J. E. SMITH, MÉM. ACAD. TURIN 5: 416. 1793

CYATHEA CUNNINGHAMII Hook. f. ex Hook. Icones Pl. 10: *t. 985* & text. 1854. Gully Fern.

This is apparently rare in cultivation for we found record of it only at the Strybing Arboretum where there is a single plant having a slender trunk 13 feet in height. The blade of the leaf is of a thin texture and the petiole has scales of two kinds, both having delicate margins which erode. The scales of the blade and axes are stellate in form somewhat resembling those of *Alsophila Colensoi* and *Hemitelia Smithii* but are mostly larger and tan to brown. Some unusual scales may be found on the costules among the sori, of a color and texture similar to the indusium, but subbullate in form and with a reddish brown, stellate apex.

Native to Australia, Tasmania and New Zealand.

CYATHEA DEALBATA (Forst.) Swartz in Schrad. Journ. 1800[2]: 94. 1801. Silver King, Silver Tree Fern.

Polypodium dealbatum Forst. Fl. Ins. Prod. 83. 1786.

The white, waxy covering on the under-surface of the leaves, which may extend to the rachis and petiole, is distinctive of the species, although it is sometimes absent or poorly developed. Roberts' Nursery has young plants

and there are specimens recording it from the Huntington Botanic Garden.

Native of New Zealand.

CYATHEA DELICATULA Maxon, Contrib. U.S. Nat. Herb. **13**: 4. 1909.

This and the following two Mexican species were introduced into cultivation by the late Frank Montoya at the La Fleur Nursery in Los Angeles and were originally called *Alsophila armata*. Unfortunately, they have not proved to be as adaptable to cultivation as the Australian or New Zealand species and only a few have survived. Herbarium specimens have been preserved of these species and it is largely from these that we have identified the remaining plants.

The pinnules and ultimate segments in this species are shorter and narrower than those of *C. fulva*, giving a more delicate aspect to the leaf.

Native of Guatemala and Mexico.

CYATHEA FULVA (Mart. & Gal.) Fée, Mém. Fam. Foug. **9**: 34. 1857.

Alsophila fulva Mart. & Gal. Mém. Acad. Brux. **15**: 78, *t. 23*. 1843.

As indicated in the previous discussion this species resembles *C. delicatula*. Both have many bullate scales on the costae, although in this species (*Fig. 9*) they may be twice as large as in *C. delicatula* (*Fig. 10*). The indusium, completely enclosing the sorus in both species, is a remarkable, iridescent, cellophane-like tissue. There is a plant in the garden of Dr. W. C. Drummond.

Native of Mexico.

CYATHEA MEXICANA Schlecht. & Cham. Linnaea **5**: 616. 1830.

This species is quite unlike the two previously men-

tioned Mexican tree ferns in having blackish spines on the petiole and in having the scales of the blade flat, whitish, and with marginal spinules some of which are red (*Fig. 11*). The pinnules are articulate, leaving clean scars on the pinna-rachises. There are plants in the garden of Dr. W. C. Drummond and at Roberts' Nursery.

Native of Mexico.

CYATHEA MEDULLARIS (Forst.) Swartz in Schrad. Journ. **1800**[2]: 94. 1801. Black Tree Fern.

Polypodium medullare Forst. Plant. Esculent. 74. 1786; Fl. Ins. Prod. 82. 1786.

This is the largest and most impressive of the tree ferns in cultivation. There is a splendid colony of them bordering the Lily Pond in Golden Gate Park, with specimens 25 feet tall or more, and with leaves up to 16 feet long. The petioles of young plants may be greenish, rather than black, and new leaves on older plants may have the petioles greenish on the upper side. The black petiole becomes brown when the leaves are dried at a high temperature. The scales of the stipe base are of two kinds, both having spinescent-serrate margins. The scales of the pinnule-rachises and costae are remarkably beautiful under magnification. The central portion is glistening white with a border of attenuated marginal spinules, some of which are red. Dr. R. C. Cooper gives an account[2] of the decorative pieces called Ponga Ware that are prepared from the trunks of this species and also mentions the former use as food of the pulp in the center of the trunk by the native Maori.

Native of New Zealand.

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[2] This JOURNAL, 47: 89–91. 1957.

HEMITELIA R. BR. PROD. FL. NOV. HOLL. 158. 1810

HEMITELIA SMITHII (Hook. f.) Hook. in Hook. & Bak. Syn. Fil. 31. 1865. Soft Tree Fern.

Cyathea Smithii Hook. f. Fl. N. Zeal. **2**: 8, *t. 72*. 1854.

The fertile leaves easily distinguish the species but sterile material poses more difficulty because of similarities with *Alsophila Colensoi*. The matter is discussed in the treatment of that species. We have seen only a small, sterile, living plant of *H. Smithii* in the Strybing Arboretum, which has leaves of an unusually thin texture.

Native of New Zealand.

GRAY HERBARIUM, HARVARD UNIVERSITY, CAMBRIDGE, MASS.

Polypodium pectinatum and P. plumula—Polypodiaceae or Grammitidaceae?

ALMA G. STOKEY

In the intermittent periods during which the grammitid ferns were placed in the genus *Polypodium* there was no question about the status of *Polypodium pectinatum* L. and *P. plumula* Humb. & Bonpl. Now it is not merely a question of the genus—*Polypodium* or *Ctenopteris*—but of the family—Polypodiaceae or Grammitidaceae. Copeland[1] in an Appendix to his monograph "*Ctenopteris* in America" includes them in a list of 12 species under the heading "Species believed to be *Ctenopteris*" with a brief statement of certain significant characters:

"*Polypodium pectinatum* Linnaeus. Large ferns; veins branching; spores bilete. A considerable number of similar ferns.

Polypodium Plumula H.B.W. Small ferns, not numerous. Paleae on rachis. Spores bilete."

[1] Philipp. Journ. Sci. 84: 381–475. 1955.

The evidence of relationship has been based entirely on the sporophyte, but in this case evidence from the gametophyte should be considered. The gametophyte is not ordinarily helpful in separating genera of the same family but may be of value in the case of genera of well-defined families.

During the last five years I have had two cultures of *P. pectinatum*: one from spores sent from Puerto Rico by Edith Scammon of the Gray Herbarium, and one from Jamaica sent by George R. Proctor, Botanist of the Institute of Jamaica. While in Jamaica in 1954, I collected material of *P. plumula* which gave a good culture. Mr. Proctor sent more spores from Jamaica in September, 1957, but the material was rather young and germination was meager. For comparison with these cultures there were available the cultures which Dr. Lenette Atkinson and I have made in our study of these two families: 37 species from 20 genera of Copeland's Polypodiaceae (excluding the grammitids), and 27 species from five genera of the Grammitidaceae including 10 species of *Ctenopteris*. The gametophytes of these two families differ in so many respects that they can be distinguished from each other readily. (An account of the gametophyte of the Grammitidaceae has recently appeared.) (Phytomorphology **8**: 391–403. 1958.)

Copeland notes the spore character: *Polypodium* has bilete spores, and *Ctenopteris* trilete, and, as is characteristic of the Grammitidaceae, they contain chlorophyll. In these two families there is a difference in the mode of germination of the spore. In the Polypodiaceae, as in most of the higher ferns, a green prothallial cell and a rhizoid emerge from the spore coat at about the same time or the rhizoid may appear first; the first rhizoid is usually colorless and grows more rapidly than the prothallial filament. Germination in the Grammitidaceae is less uniform. The most common type in our

cultures was a green filament arising from one or two bulbous basal cells; less commonly germination resulted in a mass or plate. It was exceedingly rare for a rhizoid to appear before there were three green cells or more, even as many as 40. The delay in the appearance of the first rhizoid appears to be a family character. When rhizoids do appear they are sharply set off from the green cells by their slender form and dark brown walls. The difference in germination of the two families is striking and unmistakable. Both *P. pectinatum* and *P. plumula* agree with the Polypodiaceae in the mode of germination of the spore.

There is a great difference in the extent of development of the filamentous stage in the two families. In the Polypodiaceae this is merely a short incident leading quickly to a plate if conditions for growth are favorable. In the Grammitidaceae it may be a mode of life which persists for months or even for years, the filaments forming a "turf" suggestive of the filmy-ferns. The germination filament in the Polypodiaceae is ordinarily four to eight cells long, and the filament at the base of the plate consists of one to six cells, usually three or four. The two species in question agree with the Polypodiaceae; in both there is a short filamentous stage which broadens rapidly into a plate leaving a filament of only one to five cells at its base.

The broad cordate mature thallus of *P. pectinatum* with its broad midrib is like that of other species of *Polypodium* and not like the more slender thallus of *Ctenopteris* with its thin narrow cushion. The gametophyte of *P. plumula* is also like that of the Polypodiaceae in form but is less broad than that of *P. pectinatum*. The rhizoids of the mature thallus of both species are moderately stout with light brown or rust brown walls, and are like most of the Polypodiaceae not only in aspect but in their heavy development on the ventral surface. They

are conspicuously different from the stiff slender dark brown rhizoids of the Grammitidaceae which are developed characteristically on the margin of the thallus.

Polypodium pectinatum has a sparing growth of simple hairs, mostly on the margin of both young and mature prothalli, and a few branched hairs on the ventral surface of the mature thallus. This is a common condition in many of the Polypodiaceae including four other species of *Polypodium* in our cultures, as well as nine other genera in the family. In the Grammitidaceae branched glandular hairs of unusual size are highly developed on the gametophytes of some species but are commonly found on the margin rather than on the surface. *Polypodium plumula* bore no hairs except one acicular hair on an apogamous thallus. Acicular hairs are found on the gametophyte of a few species of grammitids. One might attach more weight to the case of the one acicular hair if it had not developed on an apogamous gametophyte.

The Puerto Rico culture of *P. pectinatum* bore abundant antheridia and archegonia. Fertilization occurred, resulting in sporophytes which grew to maturity. The Jamaica culture has produced both antheridia and archegonia but so far has developed no sporophytes. The first culture of *P. plumula* had no sex organs, but began to develop apogamous embryos when three months old. Some of the sporophytes are still in cultivation. The second culture of this species grew slowly. Several gametophytes had two or three archegonia and a few antheridia, but unfortunately this culture has been the loser in a battle with fungi and algae.

The sex organs can hardly be said to offer any important evidence. Archegonia are so uniform in the higher ferns that there is no characteristic difference between those of the two families. Antheridia show more variation but there is a question if it is significant. In both

families the wall is of the three-celled type characteristic of the higher ferns. The chief variation is in the basal cell and this affects the form of the antheridium; it may be funnel-shaped or disc-shaped, as is usual in globular antheridia, or it may be elongated or almost cylindrical or vase-shaped. The common type of antheridium in *Polypodium* and, indeed, in most of the family, is the globular type, although the elongated antheridium with a more or less cylindrical or vase-shaped basal cell may be found in some species, e.g., *Polypodium chnoodes*, *Phlebodium aureum*, *Pyrrosia chinensis*, and *Selliguea feei*. The antheridia of the grammitids are usually elongated or vase-shaped.

It is of interest to note that the rate of development of the two species is that of the Polypodiaceae rather than of the Grammitidaceae. The gametophyte of *P. pectinatum* from Puerto Rico bore antheridia and archegonia in two months; that from Jamaica grown at a less favorable season matured in four months. The first culture of *P. plumula* had apogamous embryos at three months; the second had antheridia and archegonia at four months. This is unlike the Grammitidaceae, which are exceedingly slow in development. In this family the plate stage is seldom attained until three or four months, more often not until eight or ten months, or even a year. Archegonia were not found in any culture less than 10 months old.

In spite of the relative simplicity of gametophytic structure, the characteristics of the two species are sufficiently well-defined, and agree so well with those of the gametophyte of *Polypodium*, and differ in so many respects from those of *Ctenopteris*, that there appears to be a high degree of probability that these two species are properly placed in the genus *Polypodium*.

MOUNT HOLYOKE COLLEGE

The Sporangia of Three Problematic Species of Polypodium[1]

KENNETH A. WILSON

An examination of the recent literature on fern morphology and cytology makes it apparent that a great deal is being added to the knowledge and understanding of the structure and life cycles of the ferns, and also that this accumulation of information is contributing to a more natural classification of the group. Cytological evidence, however, does not appear to aid in the differentiation of the Grammitidaceae from the Polypodiaceae since their chromosome numbers are basically alike. In instances where problems arise in determining the relationship of ferns of this complex, we must rely on morphological evidence for an indication of their proper taxonomic position. Such a problem is presented by Stokey (1959) who discusses evidence from the gametophyte generation that indicates that *Polypodium plumula* Humb. & Bonpl. and *P. pectinatum* L. are properly placed in the Polypodiaceae rather than in the Grammitidaceae.

Evidence from the sporangial morphology has been sought to add new information which might aid in determining the systematic position of *Polypodium pectinatum*, *P. plumula*, and *P. amphidasyon*[2]—three ferns listed by Copeland (1955) as "Species believed to be Ctenopteris."

In a recent survey of the sporangia of many members of the Polypodiaceae and Grammitidaceae, I have de-

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[1] Continuing a series of miscellaneous notes and papers dealing with the flora of the southeastern United States made possible through the interest and support of George R. Cooley and a grant from the National Science Foundation.

[2] This study is based on material deposited in the Gray Herbarium of Harvard University; the specimens examined are cited in the legend of the illustration.

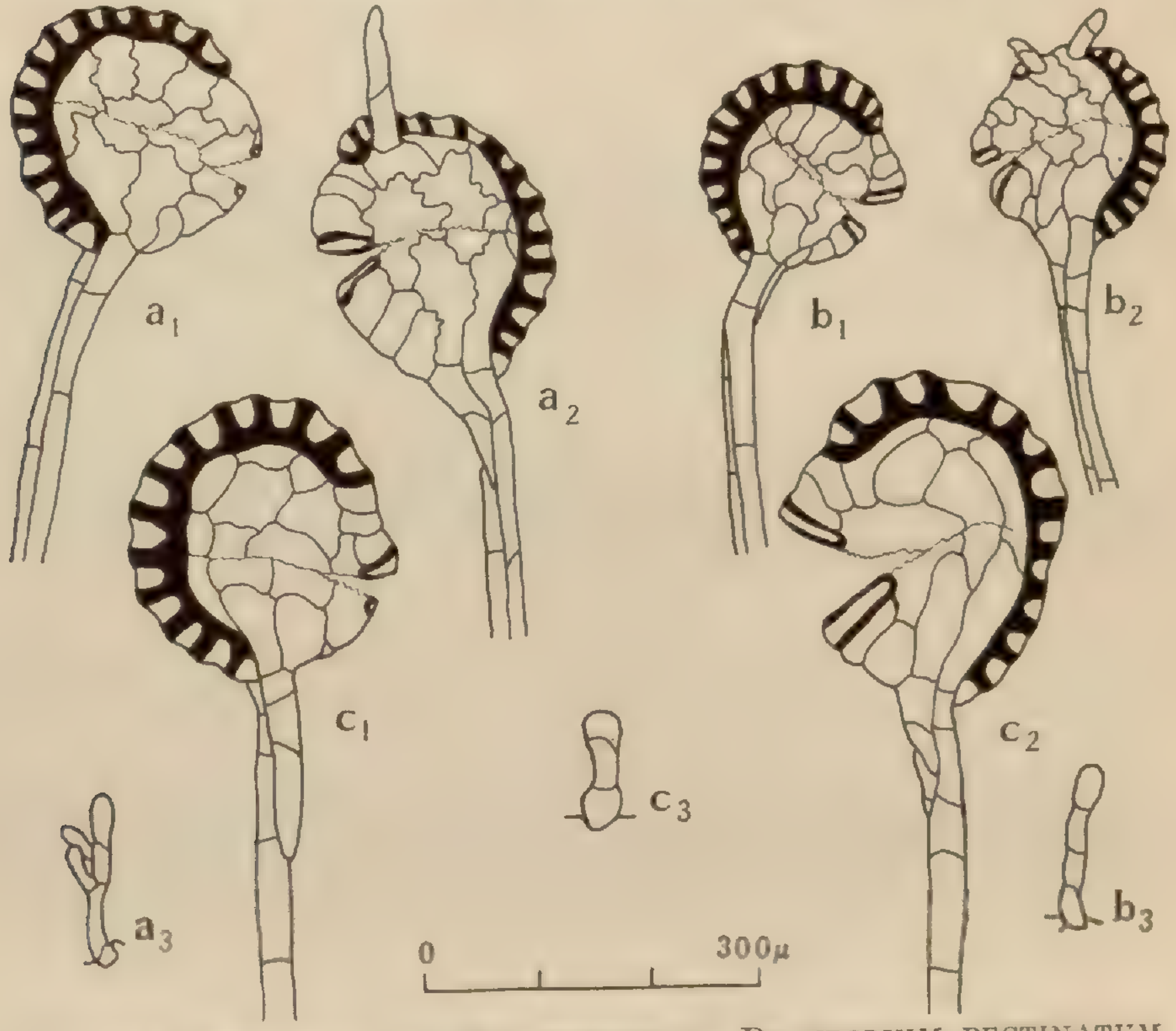
scribed the differences between the sporangia of these two families (Wilson, 1959). The sporangial capsule of the members of the Polypodiaceae is characterized by having a vertical or interrupted annulus which possesses a two-celled stomium, a series of thin-walled cells below the stomium (i.e., the hypostomium), and two or more thin-walled cells between the stomium and the indurated cells of the bow (i.e., the epistomium). The sporangial stalk of the ferns of this family is composed of two rows of cells at the base and becomes three-rowed only directly beneath the capsule. At first glance the sporangia of the Grammitidaceae seem to be identical to those of the Polypodiaceae. Indeed, there is no fundamental difference in the sporangial capsule of the two families. The significant difference is in the structure of the sporangial stalk. The Grammitidaceae possess sporangia which have only a single row of cells at the base of the stalk.

In order to determine the structure of the sporangium, one need only boil a sorus taken from an herbarium specimen in 5% sodium hydroxide, carefully dissect the sorus in a drop of water on a slide, and examine the material under a microscope.

The sporangia of both *Polypodium pectinatum* (*fig.* a_1, a_2) and *P. plumula* (*fig.* b_1, b_2) are very similar to each other, and both possess stalks which are two-rowed from the point of their attachment to the receptacle to the three-rowed portion which subtends the capsule. Of interest also are the projections or hairs of the capsule. Both species have sporangia which bear these structures, but not all of the sporangia bear them. In both species, sporangia bearing no hairs may be found intermixed with others that bear from a single hair to as many as five. The presence of the hairs is apparently of significance only on the specific level rather than on the family or generic level. Hairs and setae are known to occur

on the capsules of sporangia of species of such distantly related genera as *Thelypteris*, *Pessopteris*, *Leucostegia*, and "*Ctenopteris.*"

The morphology of the sporangia of *Polypodium pectinatum* and *P. plumula* agrees with that of the other members of the Polypodiaceae that I have studied. Thus, in view of the evidence from the gametophytes, and from



MATURE SPORANGIA AND PARAPHYSES. a, POLYPODIUM PECTINATUM (FLORIDA: A. A. EATON 538); b, POLYPODIUM PLUMULA (FLORIDA: L. M. UNDERWOOD 278); c, XIPHOPTERIS AMPHIDASYON (ECUADOR: J. P. COUTHOUY 4).

other sporophytic characters such as the bilateral spores, and the clathrate scales, there seems to be little reason to doubt that these two species are correctly placed in the Polypodiaceae.

Polypodium amphidasyon Kunze ex Mett., in sharp contrast to the above species, has sporangia which have only a single row of cells at the base of the stalk (*fig.* c_1,

c$_2$). These sporangia indicate that this fern belongs to the Grammitidaceae. Other sporophytic characters support this conclusion: The spores are tetrahedral and green, the rhizome-scales are non-clathrate, and the fronds bear long reddish-brown setae. The nature of the gametophyte is unknown, but it seems clear that *P. amphidasyon* is a grammitid fern and should be known as *Xiphopteris amphidasyon* (Kunze ex Mett.) Alston.[3]

Polypodium pectinatum, *P. plumula* and *Xiphopteris amphidasyon* all have paraphyses in their sori. Those of *P. plumula* are short and filamentous (*fig.* b_3), but they are very rare in their occurrence. The branched filamentous paraphyses of *P. pectinatum* (*fig.* a_3) occur rather frequently within the sori. *Xiphopteris amphidasyon* has extremely short paraphyses scattered among the sporangia (*fig.* c_3). So little is known about the nature of paraphyses that no explanation of their phylogenetic significance can be offered at this time.

SUMMARY

The sporangial evidence clearly indicates that *Polypodium pectinatum* and *P. plumula* are rightly placed in the Polypodiaceae. This is in complete agreement with the evidence from the gametophytes as presented by Stokey. On the other hand, sporangial evidence points to the conclusion that *Polypodium amphidasyon* is a member of the Grammitidaceae.

GRAY HERBARIUM AND ARNOLD ARBORETUM, HARVARD UNIVERSITY, CAMBRIDGE, MASSACHUSETTS.

LITERATURE CITED

Alston, A. H. G. 1957. Some Colombian ferns collected by M. Køie. Bull. Jard. Bot. Bruxelles **27**: 55–58.

[3] It is unfortunate that Copeland chose to use the generic name "Ctenopteris," and that it has since been so widely accepted. The genus was not properly published by Blume. It seems best at the moment to accept Alston's transferal to *Xiphopteris* (1957) even though this fern is a member of the "Ctenopteris" group. A more satisfactory solution must await additional taxonomic studies.

Copeland, E. B. 1955. Ctenopteris in America. Philip. Jour. Sci. **84**: 381–473.

Stokey, A. G. 1959. Polypodium pectinatum and P. plumula—Polypodiaceae or Grammitidaceae? This JOURNAL **49**: 142–146.

Wilson, K. A. 1959. Sporangia of the fern genera allied with Polypodium and Vittaria. Contrib. Gray Herb. **185**: 97–127.

The Correct Name of the Fern Usually Called Alsophila blechnoides

C. V. MORTON

There is a common tropical American fern that has long been called *Alsophila blechnoides* (L. C. Richard) Hooker, *e. g.* in Hooker and Baker, Synopsis Filicum, by Diels in Engler and Prantl, and by Christensen in Index Filicum, a disposition based chiefly on the lack of an indusium, as in *Alsophila.* In 1926, F. O. Bower[1] studied its morphology in detail, and came to the conclusion that this species differs from *Alsophila* in several important characters—in having a creeping rhizome rather than an erect caudex, in having hairs only rather than scales, and in having the sori of the "simple" rather than "gradate" type. He chose to erect a separate family for it and the related genus *Lophosoria* called the Protocyatheaceae. The characters are important and doubtless fundamental, but the erection of a separate family is scarcely necessary.

Bower called this species *Metaxya rostrata* Presl, which is correct. However, the matter was confused by Copeland, who in his Genera Filicum called it *Amphidesmium blechnoides* (L. C. Richard ex Hooker) Klotzsch. It is the purpose of this note to point out that both the generic and specific names adopted by Copeland are incorrect.

The name *Amphidesmium* dates from Schott,[2] who

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1 The Ferns 2: 282–292. 1926.
2 Gen. Fl. *sub tab.* [5]. 1834.

mentions it in an observation appended to his description of the genus *Trichopteris* Presl as follows: "Genus e Gleicheniacearum familia cui nec Trichopteris *Parker* (Polyp. Parkeri Hook. et Grev. Fil. II. t. 232, Amphidesmium *nobis*) nec Chnoophora *Kaulfuss* convenit." Thus, *Amphidesmium* is proposed as a substitute for *Trichopteris* Parker non *Trichopteris* Presl. But there is no genus "*Trichopteris* Parker." In the original description of *Polypodium Parkeri* Hook. & Grev., the synonym "*Trichopteris* n. sp. Parker" is cited, by which is meant that Parker had indicated that his material belonged as a new species in the genus *Trichopteris* Presl. However, Parker never published any description either of a species or a genus. Hooker and Greville did not accept the genus *Trichopteris*, but considered it a synonym of *Polypodium*, and consequently described the plant as *Polypodium Parkeri*. A genus *Trichopteris* Parker is therefore non-existent, and consequently Schott's renaming of it as *Amphidesmium* is invalid, being a *nomen nudum*; Schott gives no word of description.

Two years later, Presl proposed the genus *Metaxya* with a good description and figure. This is the correct name of the genus.

The specific epithet *blechnoides*, adopted by Christensen, Copeland, and others goes back ultimately to *Polypodium blechnoides* L. C. Richard, Act. Soc. Nat. Hist. Paris **1**: 114. 1791, where it is a *nomen nudum*. The reference given by Hooker in taking up *blechnoides*, i.e. *Polypodium blechnoides* Swartz, Syn. Fil. 73. 1806, is also a *nomen nudum*, Swartz merely listing Richard's species among the dubious names. The next earliest name is *Polypodium rostratum* Humb. & Bonpl. ex Willd. (1810), non *P. rostratum* Burm. (1768), *nec* Cav. (1802), *nec* Poir. 1804. Although the epithet *rostratum* is not available under the genus *Polypodium*, the species was transferred to the genus *Aspidium* by Humboldt,

Bonpland, and Kunth, in 1816, thus validating it as a new name, as of the date January, 1816. In the same year, 1816, Poiret renamed the species *Polypodium Humboldtii* Poiret. I do not know the exact date of Poiret's publication, but the probability is that it is later than January. The synonymy of the essential names is therefore as follows:

METAXYA Presl, Tent. Pterid. 59. 1836. Typus: *M. rostrata* (Willd.) Presl, the only species.

Amphidesmium Schott, Gen. Fil. *sub t.* [*5*] *in obs.* 1834, *nom. nud.*

METAXYA ROSTRATA (H.B.K.) Presl, Tent. Pterid, 60. *pl. 1, fig. 5.* 1836.

Polypodium blechnoides L. C. Rich. Act. Soc. Nat. Hist. Paris 1: 114. 1791, *nom. nud.*

Polypodium rostratum Humb. & Bonpl. ex Willd. Sp. Plant 5: 193. 1810, *non* Burm. 1768. *Illegit.*

Aspidium rostratum H.B.K., Nov. Gen. Sp. 1: 12. Jan. 1816. Considered *nom. nov.*, by Code Bot. Nom., Paris ed., Art. 72. 1956.

Polypodium Humboldtii Poir. in Lam. Encycl. Bot. Suppl. 4: 497. 1816.

Alsophila rostrata Mart. Icon. Crypt. Bras. 64. *pl 39.* 1834.

Amphidesmium rostratum J. Smith, London Journ. Bot. 1: 201. 1842.

Metaxya Parkeri J. Smith, London Journ. Bot. 1: 668. 1842.

Alsophila blechnoides Hook. Sp. Fil. 1: 35. 1844.

Amphidesmium blechnoides Klotzsch, Linnaea 20: 372. 1847.

SMITHSONIAN INSTITUTION, WASHINGTON, D. C.

Notes and News

EXCHANGE INVITED: Mr. R. Sekido is anxious to exchange specimens (either herbarium specimens or living rhizomes) with members of the American Fern Society. He can send various unusual Japanese ferns, including the rare *Asplenium oligophlebium*[1] and *Dennstaedtia scabra*.[2] His address is Tomio-cho, Nara City, Japan.

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[1] A small fern of the *A. Trichomanes* group, somewhat resembling the tropical American *A. formosum*. C.V.M.

[2] A large fern, quite similar to several species of *Microlepia*. It could be a useful introduction in southern California. C.V.M.

LOS ANGELES FERN SOCIETY:—The Los Angeles Fern Society, formed under the guidance of Dr. W. C. Drummond in 1958, now has a membership of 48. Monthly meetings are held at 7:30 p.m. on the fourth Thursday at Fern Dell Nature Museum in Griffith Park. The past year's program included a visit to Fern Dell plantings. Mrs. Yolanda Orta and Mrs. Sylvia Leatherman spoke on growing fern spores and demonstrated methods. Rare fern books were discussed by Dr. W. C. Drummond. Mr. Peter Raven spoke on Californian native ferns. Mrs. Barbara Joe Hoshizaki spoke on introduced ferns. Leading commercial and amateur growers gave a panel discussion on the cultivation of ornamental ferns. Mrs. Sylvia Leatherman presented a program on ferns of Brazil.

Plans for the second year of the society will include lectures on landscaping with ferns, visits to fern gardens, a fern forum, a glossary study period, and many other activities of general interest.

The officers for 1958 are: Mrs. Sylvia Leatherman, President; Dr. W. C. Drummond, Vice President; Mrs. Mabel Anderson, Secretary; Mrs. Hertha Solmitz, Treasurer; Mr. Jan Groot, Program Chairman; Mrs. Barbara Joe Hoshizaki, Glossary Lessons and Forum.

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American Fern Society

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ERRATUM

Page, 108, top line of legend for plate: For "FIG. 10 (LEFT): DRYOPTERIS CELSA; FIG. 11 (RIGHT): D. × SEPA-", read "FIG. 8 (LEFT): DRYOPTERIS "LEEDSII," TETRAPLOID; FIG. 9 (RIGHT):"

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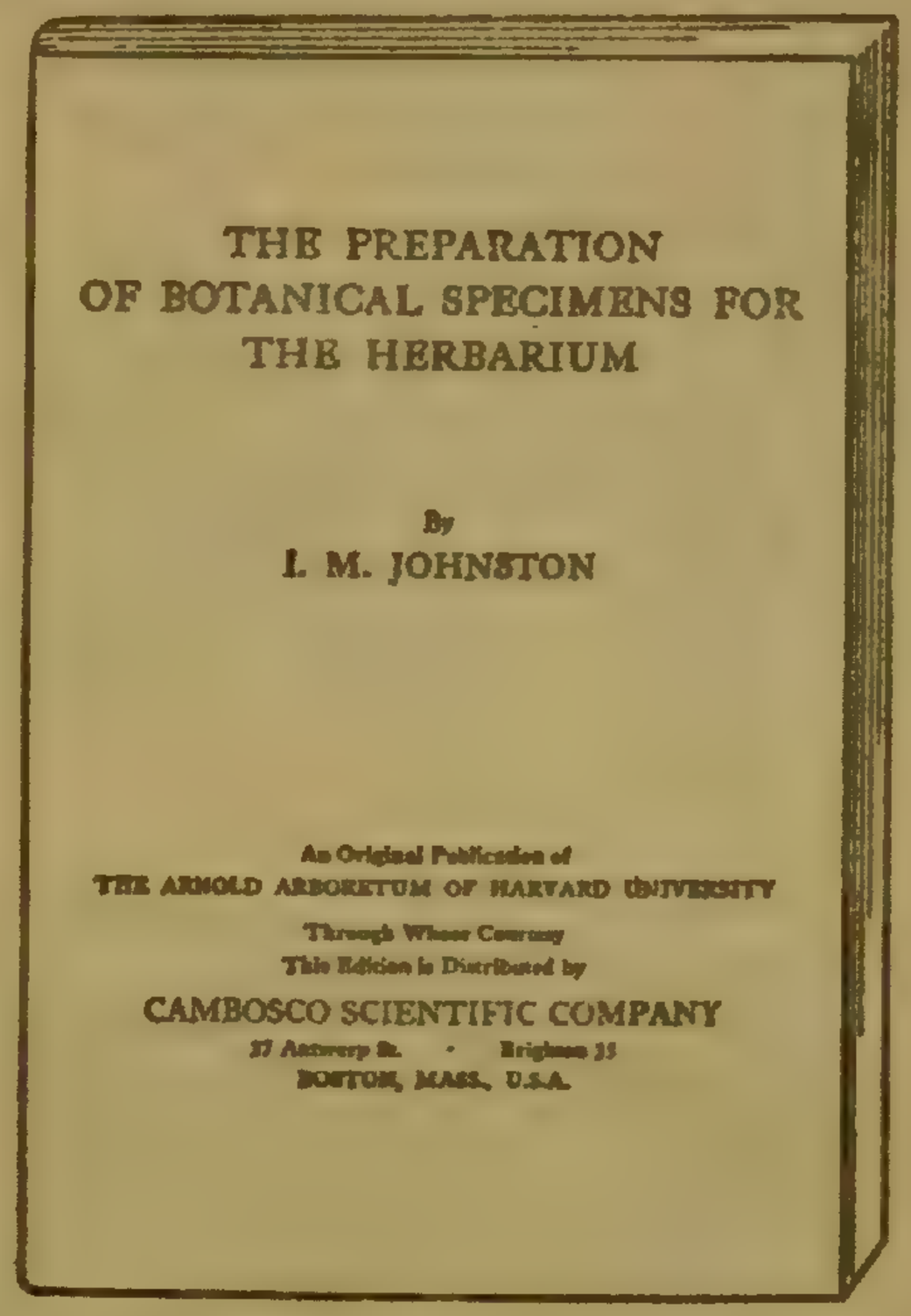

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Bacon, Miss Catharine M., 142 Chestnut Street, Albany 10, New York 1954
Baker, Miss Harriet E., 1927 Buckingham Road, Los Angeles 16, California 1941
Baker, Miss Hazel E., 7654 Central Avenue, Lemon Grove, California 1958
Baker, Prof. William H., University of Idaho, Moscow, Idaho 1947
Baldwin, Prof. John T., College of William and Mary, Williamsburg, Virginia 1953
Ballard, Mrs. F. L., Jr., 149 Northwestern Avenue, Philadelphia 18, Pennsylvania 1958
Ballard, Mr. Francis, Royal Botanic Gardens, Kew, Surrey, England 1944
Barnes, Mrs. Albert C., Latch's Lane, Merion, Pennsylvania 1926
*Barnes, Mrs. William A., 2645 Edgewood Road, Utica 3, New York 1944
Barsalou, Mrs. H. L., Sr., 1241 Linda Vista Avenue, Dayton 5, Ohio 1949
Bartlett, Prof. H. H., Department of Botany, University of Michigan, Ann Arbor, Michigan 1944
Barton, Mr. Ralph R., 517 East Alder Street, Brea, California 1957
Bartsch, Dr. Paul, "Lebanon," Gunston Hall Road, Lorton, Virginia 1911
Bateman, Mr. James A., Box 114, Slidell, Louisiana 1957
Battin, Mrs. Viola, Edgewood, Iowa 1958
Bauer, Mr. Bill, Botany Hill, Imperial, Missouri 1944
Bean, Mr. A. M., 1456 Vancouver Avenue, Burlingame, California 1957
Bean, Ralph C., 48 Emerson Street, Wakefield, Massachusetts 1920
Beardslee, Mrs. John W., Jr., 93 College Avenue, New Brunswick, New Jersey 1942
*Bechtol, Mr. L. A., c/o Almont Savings Bank, Almont, Michigan 1946
Beck, Mrs. Walter, Innisfree, Millbrook, New York 1928
Beckner, Mr. John, 736 Myrtle Way South, St. Petersburg, Florida 1952
Benedict, Mr. J. E., Jr., 945 Pennsylvania Avenue, N. W., Washington 4, D. C. 1923
Benedict, Dr. R. C., 2214 Beverly Road, Brooklyn 26, New York 1905
Benedict, Dr. Ralph H., 3106 Lapey Street, Rockford, Illinois 1958
Benedict, Mr. Richard A., 2214 Beverly Road, Brooklyn 26, New York 1952
Benson, Dr. Lyman, Pomona College, Claremont, California 1945
Berko, Mr. S. J., P. O. Box 111, Export, Pennsylvania 1947
Berryhill, Mr. Claude, P. O. Box 2934, Carmel, California 1956
Bill, Miss Bertha, 12 Boynton Street, Worcester 2, Massachusetts 1944
Bir, Mr. Sarmukh Singh, Punjab University Botany Department, Khalsa College, Amritsar, India 1955
Blake, Mrs. Anson S., Rincon Road, near Arlington Avenue, Berkeley 7, California 1945
Blake, Dr. S. F., 3416 North Glebe Road, Arlington, Virginia 1945
*Blasdell, Mr. Robert F., Department of Botany, University of Michigan, Ann Arbor, Michigan 1952
Blaydes, Dr. David E., Department of Botany, Ohio State University, Columbus 10, Ohio 1955
Blaydes, Mr. Glenn W., 214 Westwood Road, Columbus 14, Ohio 1957
Blois, Mr. William F., Jr., Route 6, Box 386, Jacksonville 7, Florida 1957
Blomquist, Prof. H. L., Duke University, Durham, North Carolina 1934
Bloom, Mr. William W., 1002 Oak Street, Valparaiso, Indiana 1948
Boardman, Mr. Charles M., 6906 Thomas Boulevard, Pittsburgh 8, Pennsylvania 1956
Boatner, Dr. Florence G., 1334 Louisiana Avenue, New Orleans 15, Louisiana 1948
Boivin, Dr. Bernard, Division of Botany, Central Experimental Farm, Department of Agriculture, Ottawa, Canada 1950

Borree, Mr. Peter, 2759 Kelly Street, Hayward, California	1953
Boutin, Mr. Fred C., 2620 North Willard Avenue, South San Gabriel, California	1957
Bowker, Mr. Bernard, 1554 N. W. Third Street, Miami, Florida	1952
Boyce, Mrs. David C., 516 West Sixth Street, Hinsdale, Illinois	1930
Boyd, Mr. Howard J., 145 West 31st Street, Eugene, Oregon	1951
Boydston, Mrs. Kathryn E., "Fernwood," Route 3, Niles, Michigan	1951
Bracelin, Mrs. H. P., 2214 Vine Street, Berkeley 9, California	1949
Brakefield, Mrs. J. L., 853 77 Way South, Birmingham, Alabama	1956
Branscomb, Mr. Donald L., Route 1, Box 45, Willits, California	1954
Branum, Miss Florence, 117 North Ewing Street, Lancaster, Ohio	1947
Brass, Mr. Leonard J., Archbold Biological Station, Lake Placid, Florida	1952
Breidenbaugh, Mrs. Okra J., R. R. 3, Bright, Ontario, Canada	1957
Bridgers, Bernard, 1809 G Street, N. W., Washington 6. D. C.	1957
Brewster, Miss Frances W., 294 Montgomery Street, Bloomfield, New Jersey	1955
Bristow, Miss Alice A., 141 Silvermine Road, New Canaan, Connecticut	1952
Bristow, Miss Helen G., 141 Silvermine Road, New Canaan, Connecticut	1952
Britton, Dr. Donald M., Department of Horticulture, University of Maryland, College Park, Maryland	1946
Brooks, Dr. Karl L., 431 East Third Street, Brooklyn 18, New York	1951
Brooks, Dr. Maurice G., Division of Forestry, West Virginia University, Morgantown, West Virginia	1926
Broun, Mr. Maurice, Hawk Mountain Sanctuary, R. D. 2, Kempton, Pennsylvania	1934
Brown, Dr. Clair A., 1180 Stanford Avenue, Baton Rouge 8, Louisiana	1952
Brown, Mr. Donald F. M., 3575 North Dixboro Road, Route 5, Ann Arbor, Michigan	1953
Brown, Mrs. Haydn L., Main Street, Atkinson, New Hampshire	1947
Brown, Mrs. Malcolm, P. O. Box 127, Ryderwood, Washington	1957
Brown, Miss Muriel P., Woodstock Valley, Connecticut	1954
Bryant, Mrs. O. S., Jr., 519 La Fayette Avenue, Owensboro, Kentucky	1956
Bugbee, Mrs. Lloyd H., Bradford, Vermont	1954
Bunker, Mrs. Arthur H., 208 East 62nd Street, New York, New York	1954
Burns, Mr. Newell J., 2137 East Bennett Avenue, Milwaukee 7, Wisconsin	1948
*Burton, Dr. Daniel F., State Teachers College, Mankato, Minnesota	1949
*Burton, Mrs. Verona Devine, State Teachers College, Mankato, Minnesota	1949
Burtt, Mrs. Harold E., 2163 North Starr Road, Columbus 12, Ohio	1953
Busfield, Mrs. Ruth R., Monroe, Washington	1957
Byers, Mr. O. J., Jr., 45 Via Lucas, San Lorenzo, California	1951
Cadbury, Dr. W. W., 274 West Main Street, Moorestown, New Jersey	1951
Calder, Dr. J. A., Division of Botany, Science Service, Department of Agriculture, Ottawa, Canada	1952
Canan, Miss Elsie D., 1023 Menoher Boulevard, Johnstown, Pennsylvania	1935
Cantelow, Mr. H. C., 2850 Benvenue Avenue, Berkeley 5, California	1956
*Capp, Seth Bunker	1915
Capurro, Dr. Roberto H., Charcas 1014-4, Buenos Aires, Argentina	1952
Carlson, Mr. T. O., 16 Hillcrest Road, Mountain Lakes, New Jersey	1946
Carroll, Col. Robert P., Virginia Military Institute, Lexington, Virginia	1938
Cascio, Mrs. Peter J., 2600 Albany Avenue, West Hartford 7, Connecticut	1935

Casebeer, Mr. Daniel H. H., Box 4034, Walker Station, Tulsa 9, Oklahoma 1956
Castellanos, Dr. Alberto, Canning 2904, Bajo C, Buenos Aires Argentina 1949
Cedarholm, Mr. O. R., Jr., 2344 Hanover Street, Palo Alto, California 1957
Chandler, Mr. Albert, 221 West Washington Avenue, Kirkwood 22, Missouri 1941
Chapin, Dr. Edward A., 505 Main Street, West Medway, Massachusetts 1953
Cheuvront, Mr. Elmer M., 239 Beaver Avenue, West Aliquippa, Pennsylvania 1948
Chillas, Mr. Richard B., Jr., 233 Winona Avenue, Philadelphia 44, Pennsylvania 1935
Cinq-Mars, Mr. Lionel, 13 Bouthillier, St. Jean, Quebec, Canada 1953
Clark, Mrs. B. Preston, 132 Marlboro Street, Boston, Massachusetts 1928
Clarke, Miss Gladys, 209 Lincoln Avenue, Takoma Park 12, Maryland 1946
Clarke, Prof. Herbert M. Biology Building, University of Wisconsin, Madison 6, Wisconsin 1948
Clarke, Mrs. Kenneth L., 261 North Orange Street, Orange, California 1957
Clausen, Dr. Robert T., Department of Botany, Cornell University, Ithaca, New York 1934
*Cobb, Mr. Boughton, 180 Madison Avenue, New York 16, New York 1946
Coen, Mrs. Teresa F., Coen's University Place Nursery, 1908 Grandview Drive, Tacoma 66, Washington 1957
Coffin, Mr. Robert L., 24 Summer Street, North Amherst, Massachusetts 1954
Coleman, Mrs. John R., 3699 Lake Avenue, Rochester 12, New York 1948
Coleman, Mrs. Stewart P., Barrett Road, Cedarhurst, Long Island, New York 1957
Collette, Dr. Alfred T., Department of Bacteriology and Botany, Syracuse University, Syracuse 10, New York 1954
Conley, Mr. Ervin G., 145 Townsend Avenue, Boothbay Harbor, Maine 1956
Connell, Mr. George A., U. S. Borax and Chemical Corporation, 630 Shatto Place, Los Angeles 5, California 1957
Constantine, Mr. Thomas S., 72 Terrace, Katonah, New York 1936
Cook, Prof. William S., Department of Botany, Louisiana State University, Baton Rouge, Louisiana 1956
Cooke, Dr. William Bridge, 1135 Wilshire Avenue, Cincinnati 30, Ohio 1939
*Cooley, Mr. George R., 100 States Street, Albany 7, New York 1955
Cooperrider, Mr. Tom, Department of Botany, State University of Iowa, Iowa City, Iowa 1955
Copeland, Dr. E. B., Department of Botany, University of California, Berkeley, California 1948
Coronado A., Mr. Pedro S., Avenida Cuba 486, Lima, Peru 1953
Correll, Dr. Donovan S., Texas Research Foundation, Renner, Texas 1935
Cotton, Mrs. Edward H., Sr., 26 Franklin Street, Northampton, Massachusetts 1953
Cotton, Miss Sally C., 718 Tenth Street, Santa Monica, California 1957
Covert, Miss Ione, 1702 Canton Avenue, Norfolk 6, Virginia 1954
Cowgill, Mr. Winston, 811 Chiltern Road, Hillsborough, California 1956
Coyne, Mr. F. Jewell, 19216 Malibu Road, Malibu, California 1958
Crandall, Miss Dorothy L., Randolph-Macon Woman's College, Box 278, Lynchburg, Virginia 1953
Crane, Mrs. Charles W., 174 Summit Avenue, Summit, New Jersey 1951
Crawford, Mr. Lloyd C., 600 Dunson Street, Andalusia, Alabama 1950
Cronkhite, Mrs. R. J., R. 2, Wapato, Washington 1957
Crotty, Prof. William J., Biology Department, Washington Square College, New York University, New York 3, New York 1954

Cutler, Mr. Alvin B., 7675 S. W. 128 Street, Miami, Florida 1954
Cutler, Dr. Hugh, Missouri Botanical Garden, St. Louis 10, Missouri 1957

Dansereau, Dr. Pierre, Institut Botanique de l'Université de Montreal, 4101 est rue Sherbrooke, Montreal, Canada 1949
Darling, Mr. Cyrus, Box 20, Marlboro, Vermont 1929
Darling, Mrs. Cyrus, Box 20, Marlboro, Vermont 1954
Darling, Mr. Thomas, Jr., 382 37th Place, S. E., Washingon 19, D. C. 1952
Darneille, Mrs. Dorothy, Route 3, Box 408, Grants Pass, Oregon 1957
Davies, Dr. P. A., 3124 Meadow Lark Avenue, Louisville 13, Kentucky 1952
Dayton, Dr. William A., 4818 24th Street, North, Arlington 7, Virginia 1953
DeJoncheere, G. J., Phys. Van Ommeran, Raboisen 40, Hamburg 1, Germany 1952
Del Conte, Mrs. Rose, 243 East San Luis Street, Salinas, California 1956
Demaree, Dr. Delzie, Townsend Hotel, Hot Springs, Arkansas 1938
Dent, Mrs. John, 2400 North Ventura Avenue, Ventura, California 1957
DePonce, Mrs. Amelia Mesa, Calle Juan Delgardo 455, Vibora, Habana, Cuba 1950
Desmond, Hon. Thomas C., 94 Broadway, Newburgh, New York 1943
DeVaul, Mr. Berkeley, 1110 Harritt Drive, Salem, Oregon 1957
DeVol, Dr. Charles E., c/o Miss Margaret Hodson, Marion College, Marion, Indiana 1938
Dezendorf, Mr. and Mrs. Burton, 401 Hasbrouch Boulevard, Oradell, New Jersey 1956
Diaz, Mr. Miguel A., P. O. Box 74, Rio Piedras, Puerto Rico 1957
Dickinson, Mrs. LaFell, West Swanzy, New Hampshire 1954
*Diddell, Mrs. W. D., 8092 Hawthorne Street, Jacksonville 6, Florida 1935
Dillard, Mrs. H. E., 3810 Bales Avenue, Kansas City 28, Missouri 1956
Dillman, Miss Paula, P. O. Box 364, Oneco, Florida 1955
Divoky, Mr. Robert Eugene, 1168 East 78th Street, Kansas City 5, Missouri 1952
Dix, Mr. W. L., 801 Crown Street, Morrisville, Pennsylvania 1933
Doepp, Prof. W., Hans Sachs Strasse 9, Marburg, Germany 1951
Donald, Mr. David W., 2296 132nd Avenue, San Leandro, California 1954
Doray, Mr. R. A., 2 Orchard Street, Greenfield, Massachusetts 1941
Dorn, Mrs. Edward J., R. F. D., Castleton-on-Hudson, New York 1956
Doster, Mrs. Charles S., 2924 Hastings Road, Birmingham, Alabama 1953
Doubleday, Mrs. Arthur W., 25 Pleasant Street, Woodstock, Vermont 1955
Doubles, Dr. James A., Department of Botany, Birmingham Southern College, Birmingham 4, Alabama 1953
Douglas, Miss Gertrude E., 32 Clinton Road, Melrose 76, Massachusetts 1951
Dowling, Mr. Curtis F., Jr., P. O. Box 178, Coral Gables 34, Florida 1950
Dressel, Mrs. Emma R., Star Route, Livingston Manor, New York 1945
Drummond, Dr. W. C., 1246 North Kings Road, Los Angeles 46, California 1956
Dunbar, Mr. Henry F., Box 194, R. F. D. 3, Kingston, New York 1938
Duncan, Mrs. Ellen, 938 Alabama, Lawrence, Kansas 1957
Duncan, Dr. Wilbur H., Department of Botany, University of Georgia, Athens, Georgia 1949
Dunham, Miss Ann, 450 Beverly Road, Ridgewood, New Jersey 1953
Dunham, Mrs. F. G., 450 Beverly Road, Ridgewood, New Jersey 1941
Dunlop, Prof. Douglas W., Route 1, Mukwonago, Wisconsin 1941
Durfee, Mr. Horton K., The Darrow School, New Lebanon, New York 1952
Durmay, Miss Florence Joyce, 3810 Woodland Avenue, West Springs, Illinois 1957
Dutch, Mrs. Herbert W., 7 Ridley Court, Glen Ridge, New Jersey 1952
Dyer, Mr. Lewis A., 104 High Street, Newburyport, Massachusetts 1956

Earle, Dr. T. T., Dinwiddie Hall, Tulane University, New Orleans 15, Louisiana 1938
East, Miss Laura A., 167 Seymour Street, Hartford 6, Connecticut 1944
Eastman, Miss Caroline M., 128 Christopher Street, Columbia, Missouri 1957
Eastman, Mrs. Kathryn, 128 Christopher Street, Columbia, Missouri 1958
Eastwood, Mr. Sidney K., 526 Madison Street, New Orleans 16, Louisiana 1956
Edwards, Mr. James L., 27 Stanford Place, Montclair, New Jersey 1932
Edwards, Mr. Robert A., Paradise, Beverly, Massachusetts 1954
Elkins, Mr. Clyde F., 1803 13th Street, Lubbock, Texas 1957
Elliot, Rev. E. A., South Stoke Vicarage, near Reading, Berkshire, England 1939
Ellis, Mr. Erl H., P. O. Box 1047, Idaho Springs, Colorado 1951
Elmore, Mrs. Fern B., 1101 East Altadena Drive, Altadena, California 1957
Emerick, A. E., 400 Bruce Street, Eaton, Ohio 1951
Emery, Mr. Dara E., 807 Moreno Road, Santa Barbara, California 1957
Emmons, Mr. Edwin T., 177 Lewis Street, Geneva, New York 1915
*Emory, Mr. David L., Box 188, Mercersburg Academy, Mercersburg, Pennsylvania 1952
Enrietta, Mr. Peter, R. R., Coal City, Illinois 1957
Eosefow, Mr. Michael K., c/o R. D. Millspaugh, Shelter Rock Road, North Hills, R. F. D., Roslyn, New York 1952
Epstein, Harold, 5 Forest Court, Larchmont, New York 1952
Evans, Mr. George F., 4030 Haines Street, San Diego 9, California 1958
Evers, Dr. Robert A., 393 Natural Resources Building, Urbana, Illinois 1930
Ewan, Prof. Joseph, Department of Botany, Tulane University, New Orleans 16, Louisiana 1930
Ewers, Mrs. Dewey H., 2615 Ocean Beach Drive, Longview, Washington 1957
Ewing, Mrs. Gifford C., Box 734, Rancho Santa Fe, California 1948
Eyerdam, Mr. Walter J., 7531 19th Avenue, N. E., Seattle 5, Washington 1949

Fagley, Dr. Frederick, 60 Grammercy Park, New York 10, New York 1932
Farrell, Mr. Thomas V., 633 Barneson, San Mateo, California 1957
Faust, Dr. Mildred E., 501 University Place, Syracuse 10, New York 1948
Feigley, Miss Margaret D., 544 Chestnut Street, Winnetka, Illinois 1949
Ferguson, Miss Ruby C., Rosharon, Texas 1957
Fessenden, Mr. G. Russell, 1703 Northern Parkway, Baltimore 12, Maryland 1937
Field, Mr. Franklin, Richmond Hill Road, Greenwich, Connecticut 1957
Fisher, C. Howard, Esq., Danemere Lodge, Danemere Street S. W. 15, London, England 1954
Fisher, Mrs. Morris, Route 1, Worden, Montana 1957
Fisher, Dr. W. B., 26 Greenville Road, Katonah, New York 1956
Fletcher, Mr. Peter, 200 East 66th Street, New York, New York 1956
Fliflet, Mr. Thorleif, 128 Kenilworth Road, Mountain Lakes, New Jersey 1947
Flo, Mrs. Spencer C., 19 James Street, Greenfield, Massachusetts 1948
Flowers, Dr. Seville, University of Utah, Salt Lake City 1, Utah 1938
Fosberg, Dr. F. R., 212 Holmes Run Road, Falls Church, Virginia 1946
Foster, Mr. Austin T., Derby Lane, Vermont 1951
Foster, Mr. F. Gordon, 10 North Terrace, Maplewood, New Jersey 1956
Foster, Mr. Lincoln, Falls Village, Connecticut 1950
Frank, Mrs. Irving H., 51 21st Avenue, San Francisco, California 1953
Franklin, Mrs. J. O., 107 Lawrence, Bruceton, Tennessee 1957
Fraser, Dr. Donald A., Petawawa Forest Experiment Station, Chalk River, Ontario, Canada 1949
Fravel, Gilbert R., 3379 26th Street, San Francisco 10, California 1957

Frehse, Mrs. Robert M., 506 West Maplehurst, Ferndale 20, Michigan 1949
Fuchs, Mr. Hans Peter, Höhe 810, Kölliken (AG.), Switzerland 1957

Gaede, Mr. Robert H., P. O. Box 309, Ridgewood, New Jersey 1956
Gannett, Mr. L. S., 120 East 16th Street, New York 3, New York 1928
Gardiner, Mrs. George N., Pond Crossing, Lawrence, Long Island, New York 1956
Gardner, Mrs. George H., 1724 Asbury Avenue, Evanston, Illinois 1956
Garrett, Mr. Ray, 309 Magnolia Street, Tampa 6, Florida 1955
Gaston, Mrs. John Zell, Box 147, Webster, Texas 1947
George, Mrs. David L., 314 Heywood Avenue, Orange, New Jersey 1954
Getze, Mr. George, Jr., 1121 Azalea Drive, Alhambra, California 1958
Giauque, Mrs. M. F. Ashley, 2643 Benvenue Avenue, Berkeley 4, California 1942
Gibson, Mr. Charles A., 732 Lee Avenue, San Leandro, California 1957
Gier, Dr. L. J., William Jewell College, Liberty, Missouri 1954
Giesy, Mr. R. M., III, P. O. Box No. 5731, Upper Arlington Branch, Columbus 21, Ohio 1954
Gilbert, Mr. Alfred H., Dorset, Vermont 1957
Gilbert, Dr. Neal W., 2031 A Central Road, Fort Lee, New Jersey 1940
Glasgow, Mrs. Robert D., 1013 Washington Avenue, Albany 6, New York 1951
Gliddon, Mrs. Gordon H., Hanover, New Hampshire 1957
Goldwasser, Mrs. Martin, 24 Willow Street, Brooklyn 2, New York 1953
Goodman, Prof. George J., Department of Plant Sciences, University of Oklahoma, Norman, Oklahoma 1949
Goslin, Mr. Charles R., 726 East King Street, Lancaster, Ohio 1953
Gottscho, Mr. Samuel H., 150-35 86th Avenue, Jamaica 32, New York, New York 1953
Grace, Mrs. Charles, Hilton Road, Slingerlands, New York 1951
Graf, Mr. Alfred Byrd, Julius Roehrs Co., East Rutherford, New Jersey 1953
Grajek, Mr. A. C., 2928 South 15th Street, Milwaukee, Wisconsin 1949
Grant, Mrs. Hannabelle Horton, 5521 Ameston Avenue, Encino, California 1958
Graves, Miss E. Irene, 237 Summer Street, Bridgewater, Massachusetts 1943
*Greene, Mr. Frank C., Forest Haven Apartment, 2838 Forest Avenue, Kansas City 9, Missouri 1913
Grether, Mr. David F., State Teachers College, St. Cloud, Minnesota 1950
Grim, Mrs. Robert I., 1494 Lupton Avenue, San José 25, California 1956
Groff, Miss Mary E., 108 Charles Road, Lancaster, Pennsylvania 1933
Gross, Mr. H., 16621 Madison Street, Cleveland 7, Ohio 1958
Grunden, Mrs. Wayne, 5 Crane Road, Mountain Lakes, New Jersey 1957
Gunnison, Mrs. R. M., Quaker Acres, Pawling, New York 1941

Haas, Dr. Flora A., R. F. D. 2, Apopka, Florida 1917
Hagenah, Mr. Dale J., 164 Westchester Way, Birmingham, Michigan 1948
Halbeisen, Mr. Robert, 1963 Glynn Court, Detroit 6, Michigan 1951
Hall, Miss Bessie V., Route 2, Box 837, Exeter, California 1957
Hall, Mr. Neill D., 1225 East 95th Street, Seattle 15, Washington 1957
Hallenbeck, Mr. Esly, 14 Washington Road, Scotia, New York 1938
Hammond, Mrs. Maynard C., Box 222, Sparrow Bush, New York 1953
Hampton, Miss Ann, 185 Whiting Street, Grass Valley, California 1957
Hanlon, Mrs. W. A., 1032 North Main, Gresham, Oregon 1957
Hardison, Mrs. Herman H. H., 206 Washington Street, Wadesboro, North Carolina 1956
Hardy, Miss Ruth W., Red Cedar Wild Flower Nursery, South Canaan Road, Route 7, Falls Village, Connecticut 1949
Harley, Mrs. Winifred J., Ganta Mission, Ganta, Liberia 1956

Harris, Mr. E. V. E., 2162 33rd Street, Sacramento 17, California 1957
Harrison, Mrs. Robert C., 5101 Cary Street Road, Richmond, Virginia 1953
Harsh, Mrs. George, 383 Greenway Road, Memphis 17, Tennessee 1956
Hart, Mr. Cecil, 132 North Third Street, Montebello, California 1955
Hartman, Miss Emily, Department of Biology, California State Polytechnic College, San Luis Obispo, California 1954
Hartsoe, Miss Inez, 742 West Court Street, Piggott, Arkansas 1954
Hatley, Mrs. Katherine P., 4358 Lyceum Avenue, Mar Vista 66, California 1957
Haupt, Mr. Walter J., 117 West Adalee Street, Tampa 3, Florida 1957
Hazeltine, Mrs. Inez, Oakdale Drive, Box 82-B, Austin, Texas 1957
Heath, Mrs. Victoria, 630 Highland Avenue, Piedmont 11, California 1952
Hedgwood, Miss Muriel P., 402 Randolph Street, Radford, Virginia 1952
Heimer, Mrs. Haldor E., D. C. C. M., Ifumo/Monkoto, Belgian Congo, Africa 1958
Heinzelman, Edward G., 267 Southern Avenue, Chillicothe, Ohio 1957
Hennig, Mr. R. W., R. D. 1, Middle Grove, New York 1956
Henry, Dr. LeRoy K., Curator of Botany, Carnegie Museum, Pittsburgh 13, Pennsylvania 1955
Hewitt, Mrs. Josiah M., Twin Beeches, Holmdel, New Jersey 1958
Higman, Mr. Harry W., 12750 39th Street, N. E., Seattle 55, Washington 1932
Hiltunen, Mr. Jarl, c/o Biology Department, Wayne State University, Detroit 2, Michigan 1956
*Hires, Miss Clara S., 152 Glen Avenue, Millburn, New Jersey 1941
Hitchcock, Mrs. Dorothy M., P. O. Box 822, Hanover, New Hampshire 1957
Hodge, Dr. Walter H., Longwood Gardens, Kennett Square, Pennsylvania 1956
Holdridge, Dr. L. R., c/o Ministry of Agriculture, San Jose, Costa Rica 1949
Holliger, Dr. Herbert H., Huron, Ohio 1949
Holttum, Prof. R. E., 80 Mortlake Road, Kew Gardens, Richmond, Surrey, England 1957
Hood, Mrs. Vance, 2001 Foxhall Road, N. W., Washington 7, D. C. 1951
Horn, Mr. A. E., 33-52 156th Street, Flushing 54, New York, New York 1956
Horr, Prof. W. H., Department of Botany, University of Kansas, Lawrence, Kansas 1955
Hoshizaki, Mrs. Barbara Joe, 565 North Westmoreland, Los Angeles 4, California 1953
Hougardy, Miss Frances, 625 South Baywood Avenue, San Jose 28, California 1958
Howard, Miss Freda C., 7 St. Clair Street, Ticonderoga, New York 1947
Howe, Mrs. Ruth, 5240 Noble Avenue, Van Nuys, California 1957
Howell, Mr. John Thomas, California Academy of Sciences, Golden Gate Park, San Francisco 18, California 1952
Hoyt, Mrs. J. V., 4700 Avenue A, Beaumont, Texas 1956
*Hunnewell, Mr. Francis Welles, Washington Street, Wellesley 81, Massachusetts 1915
Hunsaker, Mrs. Jerome C., 10 Louisburg Square, Boston 8, Massachusetts 1952
Hutchison, Mr. Paul C., University of California Botanical Gardens, University of California, Berkeley 4, California 1956
Huttleston, Dr. Donald G., Longwood Gardens, Kennett Square, Pennsylvania 1956

Iler, Mr. Arthur J., 2444 Hermosa Avenue, Hermosa Beach, California 1957
Imshaug, Dr. Henry A., Department of Natural Sciences, Michigan State University, East Lansing, Michigan 1940
Irving, Mr. F. N., 1707 Lamont Street, N. W., Washington, D. C. 1940

James, Mr. Arthur, Delta Flowers, 4249 7th Street, S. W., Canton 10, Ohio 1957
James, Mrs. Phil, 5620 S. W. 67th Avenue, Miami, Florida 1957
Jenks, Mrs. J. C., 6807 DeLongpre Avenue, Hollywood 28, California 1958
Jennings, Dr. Otto Emery, Carnegie Museum, Pittsburgh, Pennsylvania 1911
Johnson, Mr. Eldon H., College Highway, Southwick, Massachusetts 1952
Johnson, Mr. Martin C., 22276 Oak Avenue, Los Altos, California 1957
Johnson, Dr. S. H., 1549 N. W. 68th Street, Miami 47, Florida 1957
Johnson, Mrs. W. Keating, Ridge Pike, above City Line, Roxborough, Philadelphia 28, Pennsylvania 1948
Johnston, Dr. James W., Jr., Georgetown University, 3900 Reservoir Road, N. W., Washington, D. C. 1952
Johnston, Mr. William S., 65 Morris Lane, Scarsdale, New York 1950
Jones, Prof. G. N., Department of Botany, University of Illinois, Urbana, Illinois 1945
Jones, Mrs. Thomas B., 1131 Prescott Street, McKeesport, Pennsylvania 1958
Jost, Mrs. Norma I., 4217 Fair Avenue, North Hollywood, California 1957
Juilly, Mr. Marcel E., 86 West Blithedale, Mill Valley, California 1957
Jury, Mr. Felix M., Tikorangi, Waitara, New Zealand 1957

Kaye, Mr. Fred W., 1961 West Verdugo Boulevard, Montrose, California 1941
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Kern, Mrs. Donald, R. F. D., Ghent, New York 1957
Ketel, Mrs. Henry, 783 South Shore Drive, Holland, Michigan 1957
Kiener, Dr. Walter, 1242 Pawnee Street, Lincoln 2, Nebraska 1949
Killip, Mr. E. P., 620 Eaton Street, Key West, Florida 1916
Kimnach, Mr. Myron, 5918 Jordan, El Cerrito 9, California 1953
Kincaid, Mrs. Henry E., 416 Barry Avenue, Mamaroneck, New York 1957
Kingsley, Mrs. Darwin P., Country Club Road, New Canaan, Connecticut 1958
Kinney, Mr. Joseph H., 2230 Middlesex Drive, Toledo 6, Ohio 1957
Klebingat, Captain Fred K., 873 22nd Street, San Pedro, California 1957
Kleinschmidt, Mr. Walter F., Botanical Gardens, University of Michigan, 1404 Iroquois Drive, Ann Arbor, Michigan 1952
Knable, Mr. John P., II, 172 Spring Grove Road, Pittsburgh 32, Pennsylvania 1941
Knobloch, Dr. Irving W., Department of Natural Science, Michigan State University, East Lansing, Michigan 1933
Knotek, Mr. Joseph C., 2021 Superior Street, Racine, Wisconsin 1947
Knox, Mrs. William C., 649 Isle of Palms, Fort Lauderdale, Florida 1951
Koeniger, Mrs. Florence, 6 Walsh Lane, Fairfax, California 1945
Koster, Mr. Hollis, 125 North 21st Street, Philadelphia 3, Pennsylvania 1940
Kozloff, Prof. Eugene N., Department of Biology, Lewis and Clark College, Portland 1, Oregon 1948
Kramer, Dr. Karl U., Botanisch Museum en Herbarium, 106 Lange Nieuwstraat, Utrecht, The Netherlands 1955
Kraseman, Mr. Art, 631 North Fair Oaks Street, Sunnyvale, California 1958
Kucyniak, Mr. James, 4101 East Sherbrooke Street, Montreal, Canada 1953
Kunneke, Mr. J. W., 2307 Village Drive, Louisville 2, Kentucky 1948
Kushner, Mr. A. L., 103 Weber Building, Lake Charles, Louisiana 1958

Lampton, Dr. Robert K., 23 North Terrace, Maplewood, New Jersey 1953
Lawton, Dr. Elva, Department of Botany, Hunter College, 695 Park Avenue, New York 21, New York 1926

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Leatherman, Mrs. Sylvia B., 2637 North Lee Avenue, El Monte, California 1956
Lee, Mr. Ed, 6427 Pinehaven Road, Oakland 11, California 1949
Lee, Mr. Frederic P., 7401 Glenbrook Road, Bethesda 14, Maryland 1953
Legrand, Miss Mona Rose, Labadieville, Louisiana 1953
Lehr, Mr. J. Harry, 75 Herrick Avenue, Spring Valley, New York 1953
Lengel, Miss Patricia A., Department of Biology, College of Wooster, Wooster, Ohio 1957
Leonard, Mr. E. C., Smithsonian Institution, Washington 25, D. C. 1920
Liggett, Mr. W. E., 700 Swarthmore Lane, University City 24, Missouri 1940
Lippert, Mr. George, Brown Road, Albion, New York 1955
Lippincott, Mrs. Ruth, 56 La Cuesta Drive, Orinda, California 1953
Litch, Mr. C. M., 94 Summer Street, Fitchburg, Massachusetts 1916
Litchfield, Mrs. Norman, Barry Road, Quaker Farms, R. F. D. 2, Southbury, Connecticut 1949
Little, Dr. Elbert L., Jr., Forest Service, U. S. Department of Agriculture, Washington 25, D. C. 1946
Lloyd, Mr. Cyrus, Union Mills, Indiana 1957
Lloyd, Mrs. Robert H., 7 Homewood Avenue, Hamilton, Ontario, Canada 1954
Locke, Mr. John F., Box 1568, State College, Mississippi 1949
Logan, Mr. Harry, Whitney Street, Westport, Connecticut 1953
Logemann, Mrs. Hugo, 17 Heath's Bridge Road, Concord, Massachusetts 1957
*Logue, Dr. Everett G., First National Bank Building, Williamsport, Pennsylvania 1920
Lommasson, Dr. Robert C., Department of Botany, University of Nebraska, Lincoln 8, Nebraska 1949
Long, Dr. Bayard, 250 Ashbourne Road, Elkins Park, Philadelphia 17, Pennsylvania 1911
Looser, Dr. Gualterio, Casilla 5542, Santiago 6, Chile 1949
Lord, Mr. Arthur R., Route 1, Box 113, Palos Park, Illinois 1952
Lord, Mrs. Marie L., 101 Clay Street, Burlington, Iowa 1940
Loughbridge, Dr. Gasper, Culver Stockton College, Canton, Missouri 1949
*Lowe, Mrs. Frank E., Box 65, Harrison, Maine 1917
Lownes, Mr. Albert E., P. O. Box 1531, Providence, Rhode Island 1924
Luhr, Mrs. Arthur, 555 Kellogg Avenue, Palo Alto, California 1941
Lynch, Mr. David, 3679 Highwood Drive, S. E., Washington 20, D. C. 1952
Lyon, Mrs. A. S., 11815 Juniette Street, Culver City, California 1958
Lyonnet, Prof. Pierre, Colegio Cristobal Colon, Sadi Carnot 38, Mexico D. F., Mexico 1948

MacFadden, Mrs. Fay A., 5450 Carlin Street, Los Angeles 16, California 1953
Mackinlay, Mrs. Mabel, 2508 North Portland Boulevard, Portland 17, Oregon 1957
Magale, Mrs. J. F., 437 Sherwood Road, Shreveport, Louisiana 1956
Mansfield, Dr. William, 371 Kenwood Avenue, Delmar, New York 1922
Manton, Dr. Irene, Department of Botany, The University, Leeds, England 1957
*Marble, Mr. John E., 1313 Garfield Avenue, South Pasadena, California 1928
Marengo, Dr. Norman P., 123 Leverich Street, Hempstead, New York 1955
Marengo, Mrs. Norman P., 123 Leverich Street, Hempstead, New York 1955
Mark, Miss Clara G., 270 South State Street, Westerville, Ohio 1913
Markowitz, Mr. Arnold L., 60 East Ninth Street, New York 3, New York 1958
Marsh, Miss H. M., 481 Dolores Avenue, San Leandro, California 1957
Marshall, Dr. Frank A., 2202 Palisade Avenue, Weehawken, New Jersey 1953

Martin, Mr. Mulford, New York University, Washington Square, New York 3, New York 1956
Masek, Mr. John, Apopka, Florida 1935
Mason, Miss Esther E., 2523 Montgomery Street, Louisville 12, Kentucky 1955
Massey, Prof. A. B., Virginia Polytechnic Institute, Blacksburg, Virginia 1935
Mattuket, Mrs. Gladys, 314 North Rural Drive, Monterey Park, California 1956
McAvoy, Dr. Blanche, 5476 Foley Road, Cincinnati 38, Ohio 1920
McCauley, Dr. Robert H., Jr., 906 Potomac Avenue, Hagerstown, Maryland 1941
McClung, Mrs. William D., 16 Park Place, Richwood, West Virginia 1955
McCool, Mrs. William P., 2 Beekman Place, New York 22, New York 1957
McCoy, Dr. Thomas N., Department of Science, Bethal College, Hopkinsville, Kentucky 1934
McDowell, Gladstone W., 328 Heard Street, Elberton, Georgia 1947
McElhaney, Miss Mary, 117 East Morton Street, Dennison, Texas 1957
McGilliard, Miss Eleanor, Department of Biology, University of Chattanooga, Chattanooga, Tennessee 1935
McGregor, Dr. Ronald L., Department of Botany, University of Kansas, Lawrence, Kansas 1946
McGuire, Mrs. Diane Koshal, 237 Sanford Street, Rochester, New York 1957
McIlvane, Dr. Harold, Box 155, University Station, Moscow, Idaho 1949
McKennon, Mrs. Marie Walsh, P. O. Box 155, Morro Bay, California 1957
McLean, Mr. Robert, The Evening and Sunday Bulletin, Philadelphia 6, Pennsylvania 1954
McWilliam, Miss Aileen L., 711 Magnolia Avenue, Mena, Arkansas 1954
Merrell, Miss Elinor, 18 East 69th Street, New York 21, New York 1952
Merrell, Mrs. Muriel, 823 North Laurel Avenue, Los Angeles 46, California 1956
Mickel, Mr. John T., 1047 Martin Place, Ann Arbor, Michigan 1957
Middendorf, Miss Mary, 5724 Montezuma Road, San Diego 15, California 1958
Milan, Mrs. Doris, 4145 South Rockford Place, Tulsa 5, Oklahoma 1954
Miles, Miss Verda B., Box 691, Redlands, California 1956
Miller, Miss Isabelle, 3500 Fairview Avenue, Catonsville 28, Maryland 1953
Millspaugh, Mr. Robert, Shelter Rock Road, North Hills, R. F. D., Roslyn, New York 1952
Milne, Dr. D. M., Bank Commerce Building, Room 805, Portland 3, Maine 1947
Mitchell, Mr. James E., Route 3, Barre, Vermont 1952
Mohlenbrock, Dr. Robert H., Department of Botany, Southern Illinois University, Carbondale, Illinois 1955
Mohr, Mr. Charles E., Audubon Nature Center, Riverside Road, Greenwich, Connecticut 1954
*Monahan, Mrs. Alfred H., 1315 Tower Avenue, Raymond, Washington 1957
Monish, Miss Barbara, Chester Street, Chester, New Hampshire 1957
Montoya, Mr. Frank X., LaFleur Nurseries, 11373 Pico Boulevard, West Los Angeles 64, California 1956
Moon, Mrs. Charles, 4107 West Woodbine Street, Chevy Chase 15, Maryland 1952
Moon, Mrs. Neil S., 25 Edgewater Lane, Rochester 17, New York 1955
Moore, Mrs. Annette, Route 1, Box 323, Old Hickory, Tennessee 1956
Moore, Mr. Charles F., P. O. Box 8, Brevard, North Carolina 1957
Moore, Dr. Dwight M., Department of Forestry, Arkansas A. and M. College, College Heights, Arkansas 1935
Moore, Miss Jewel, Box 56, Arkansas State Teachers College, Normal Station, Conway, Arkansas 1947
*Moore, Dr. John W., Department of Botany, University of Minnesota, Minneapolis 14, Minnesota 1946

Morgan, Dr. D. P., 340 East 72nd Street, New York, New York 1954
Morgan, Mrs. Weld, 54 West Street, Worcester, Massachusetts 1943
Morton, Mr. C. V., Smithsonian Institution, Washington 25, D. C. 1940
Moul, Dr. Edwin T., Department of Botany, Rutgers University, New Brunswick, New Jersey 1945
Muckenthaler, Miss Joan, 1404 North Lowell, Santa Ana, California 1957
Mueller, Mr. Arnold W., 1801 Meadow Avenue, Manhattan Beach, California 1956
Muenscher, Dr. W. C., 1001 Highland Road, Ithaca, New York 1949
Murray, Miss Mary Aileen, Department of Biology, DePaul University, 1036 Belden Avenue, Chicago 14, Illinois 1949
Mutchler, Miss Marjorie, 71 West Eighth Street, Bayonne, New Jersey 1942
Myers, Dr. Charles L. R., 1409 Lincoln Avenue, Prospect Park, Pennsylvania 1957
Myers, Dr. R. M., Western Illinois State College, Macomb, Illinois 1947

Naylor, Mr. Richard M., 2835 Ash Street, Denver 7, Colorado 1952
Neidorf, Mr. Charles, 910 Sheridan Avenue, New York 51, New York 1937
Newell, Mr. Chauncey Jackson, Alstead, New Hampshire 1902
Nicklaus, Mrs. Mildred, Beaver, Oregon 1956
Nishida, Mr. Makoto, Biological Institute, Chiba University, Konakadai, Chiba, Japan 1953
Norcross, Mr. Arthur D., 244 Madison Avenue, New York 16, New York 1952
Norton, Mr. Leroy F., Box 123, Presque Isle, Maine 1941
Noyes, Miss Elmira E., 931 Baldwin Avenue, Norfolk 7, Virginia 1893
Noyes, Mr. Robert J., P. O. Box 559, Marion, North Carolina 1957
Nunan, Mrs. Hilda S., 1105 Eighth Street, Eureka, California 1949

O'Donohue, Mrs. J. J., 60 Lane Place, Atherton, California 1956
Ogden, Mrs. E. C., 175 Adams Street, Delmar, New York 1937
Oliver, Mr. William F., Jr., Box 67, Baldwin, Florida 1955
Oppel, Miss Ramona, P. O. Box 145, Rio Nido, California 1957
Orta, Miss Yolanda, 12312 Braddock Drive, Culver City, California 1956
Osterlund, Mr. Peter, Route 3, Luck, Wisconsin 1920
Otis, Dr. Mabel H., 815 Fifth Avenue Building, Moline, Illinois 1933
Otto, Mr. Robert W., 145 Ridge Park Avenue, Stamford, Connecticut 1954
Otto, Mrs. Virginia D., 145 Ridge Park Avenue, Stamford, Connecticut 1954
Ownbey, Dr. Gerald B., Department of Botany, University of Minnesota, Minneapolis 14, Minnesota 1951

Paine, Mr. George H., Jr., 446 Ludlow Highway, Ludlow, Kentucky 1955
Palmer, Mr. Ernest J., 321 South Main Street, Webb City, Missouri 1909
Parsons, Mr. Dudley L., 55 Marcourt Drive, Chappaqua, New York 1958
Peck, Mrs. Arthur N., 215 Hollywood Crossing, Cedarhurst, Long Island, New York 1953
*Perry, Mr. David H., 251 Dorking Road, Rochester 10, New York 1953
Perry, Mrs. J. G., 2180 Fremore, Beaumont, Texas 1957
Peters, Lt. Comdr. George H., 175 East Seaman Avenue, Freeport, New York 1940
Peterson, Miss Ethel, 36 Ridge Road, Cos Cob, Connecticut 1952
Peterson, Mrs. Mamie M., 1247 Castro Street, Hayward, California 1957
Phair, Miss Gertrude G., 804 East 19th Street, Brooklyn 30, New York 1916
Phelps, Dr. Orra A., Wilton, New York 1952
Phillips, Prof. Walter S., Department of Botany, University of Arizona, Tucson, Arizona 1945

Pichi-Sermolli, Dr. Rodolfo, Istituto Botanico, Universita di Firenze, 4 Via Lamarmora, Firenze, Italy 1941
Pisler, Mr. Edward, 157 Havelock Street, Toronto 4, Ontario, Canada 1957
Plass, Mrs. Raymond B., 90 Woodland Way, Piedmont 11, California 1957
Plate, Miss Emma, 344 Highwood Avenue, Leonia, New Jersey 1955
Poelt, Dr. J., Botanische Staatssammlung, Menzingerstrasse 67, München 38, Germany 1956
*Polunin, Dr. Nicholas, Department of Botany, College of Arts and Sciences, Baghdad, Iraq 1950
Pond, Mr. Bremer W., Pittsburg, New Hampshire 1910
Poole, Dr. James P., Department of Botany, Dartmouth College, Hanover, New Hampshire 1940
Pope, Col. Allan M., Mount Holly Road, Katonah, New York 1956
Potter, Mr. L. Henry, West Rutland, Vermont 1957
Powell, Mr. T. Y., 316 Pike Road, Benton, Arkansas 1956
Prather, Mrs. Tina, 590 Temple Hills Drive, Laguna Beach, California 1957
Pratt, Mr. Waldo Todd, 84 Maplewood Avenue, West Hartford 7, Connecticut 1957
Pretz, Harold W., 123 South 17th Street, Allentown, Pennsylvania 1909
Prickett, Mrs. H. E., Box 296, Wheeler, Oregon 1957
Pringle, Mr. James Scott, 108 Academy Street, Laconia, New Hampshire 1955
Proctor, Mr. George R., Science Museum, The Institute of Jamaica, Kingston, Jamaica, B. W. I. 1938
Prosser, Capt. Albert L., Box H, Springvale, Maine 1953

Quadfassel, Dr. Fred A., Veterans Administration Hospital, Boston 30, Massachusetts 1952

Rankin, Miss Mary D., 2248 Seminary Avenue, Oakland, California 1957
*Rapp, Prof. William F., Jr., 430 Ivy Avenue, Crete, Nebraska 1943
Ray, Dr. R. P., Head, Department of Botany, Patna University, Patna, India 1957
Raymond, Mr. Marcel, Montreal Botanical Garden, 4101 East Sherbrooke Street, Montreal, Canada 1952
Ream, Mr. Robert R., 825 West Dayton Street, Madison, Wisconsin 1958
Reed, Dr. Clyde F., 10105 Harford Road, Baltimore 34, Maryland 1950
Reganse, Mr. Joseph, 2379 32nd Street, Astoria, New York, New York 1956
Reid, Mrs. Alex D., 260 Boulevard, Mountain Lakes, New Jersey 1948
Rembert, Mrs. R. M., Rockledge, Florida 1944
Rhodes, Mrs. Marion B., Woodstock Valley, Connecticut 1954
Richmond, Miss Winona M., Richmond's Nursery, 324 River Street, Santa Cruz, California 1957
Risley, Mr. Ronald L., 1030 Stratford Drive, Encinitas, California 1956
Ritchie, Mr. J. C., Department of Botany, University of Manitoba, Winnepeg, Canada 1954
Ritter, Mrs. Charlotte, 17109 Burton Street, Van Nuys, California 1957
Roberts, Mr. Harry K., Box 64, Guerneville, California 1957
Roberts, Mrs. M. H., Rose Lane Farm, R. R. 2, Louisburg, Kansas 1954
Robinson, Mr. Ray A., 720 1/2 Ocean View, Monrovia, California 1957
Rock, Mr. Howard F. L., Department of Botany, University of Tennessee, Knoxville, Tennessee 1954
Rogers, Mrs. Charles H., 20 Haslet Avenue, Princeton, New Jersey 1941

Rogers, Dr. Donald P., Department of Botany, University of Illinois, Urbana, Illinois 1957
Rogers, Mrs. J. R., 3107 Union Street, Eureka, California 1948
Rogers, Mr. John B., 4316 Stewart Avenue, Los Angeles 66, California 1957
Root, Mr. Winthrop H., 128 Main Street, Williamstown, Massachusetts 1957
Rossignol, Dr. Gilbert R., 1010 East Park Avenue, Savannah, Georgia 1954
Rowse, Mr. J. M., 477 Pettis Avenue, Mountain View, California 1958
Rudine, Mrs. Clifford, 39 San Carlos Avenue, Sausalito, California 1957
Ruegger, Dr. Arthur, Ahornstrasse 10, Bottmingen BL, Switzerland 1957
Runyon, Mrs. Winifred, Box 246, Courtland, California 1952
*Rusk, Miss Hester M., 74 Carson Avenue, Metuchen, New Jersey 1934
*Rust, Mr. H. B., 1507 Ridge Road, Birmingham 9, Alabama 1944

Samuelsen, Mr. Manford L., 25 Mariposa Avenue, Los Gatos, California 1957
Sanchez, M., Sr. Hernando, Montes Urales 630, Mexico City 10, Mexico 1951
Saunders, Mr. Patrick J., 490 Vincente Avenue, Berkeley 7, California 1957
Scamman, Miss Edith, 474 Portland Road, Saco, Maine 1937
*Schaeffer, Mr. Robert L., Jr., 30 North Eighth Street, Allentown, Pennsylvania 1949
Schechter, Mr. Victor, City College of New York, Convent Avenue and 139th Street, New York 31, New York 1952
Scherer, Mr. Milton E., M. C. M. T. Quarters 20, Sault St. Marie, Michigan 1957
Scherer, Mrs. Milton E., M. C. M. T. Quarters 20, Sault St. Marie, Michigan 1958
Schmidt, Miss Claudia, 39 Ely Avenue, West Springfield, Massachusetts 1937
Schmidt, Mr. William E., 355 Lambert Avenue, Palo Alto, California 1957
Schmitz, Mr. John E., 4702 East El Segundo Boulevard, Compton 2, California 1952
Schnakenberg, Henry, Box 41, Newtown, Connecticut 1957
Schultz, Mr. Albert B., Jr., Penryn Park, Port Hope, Ontario, Canada 1955
Schultz, Mrs. Clara, R. D. 1, Stillwater, New York 1955
Schurr, Mrs. Ruth, 312 South Summit Street, Bowling Green, Ohio 1955
Schwarz, Mr. A. J., 2509 East 170 Street, Seattle 55, Washington 1957
Scott, Mrs. J. Lewis, 208 Camberwell Drive, Pittsburgh 38, Pennsylvania 1956
Scudder, Miss Anna E., St. Margaret's School, 565 Chase Parkway, Waterbury 20, Connecticut 1953
Scully, Dr. Francis J., 904 Medical Arts Building, Hot Springs, Arkansas 1934
Sedgwick, Mr. J. H., 5922 Prospect Road, Peoria 4, Illinois 1941
Sedgwick, Dr. Paul J., Department of Bacteriology and Botany, Syracuse University, Syracuse 10, New York 1952
Sener, Miss Ruth, 233 Charlotte Street, Lancaster, Pennsylvania 1932
Seward, Mr. Robert A., 2839 Yard Street, Oroville, California 1958
Seymour, Mr. George W., Keuka Park, Yates County, New York 1941
Shackleton, Mr. Walter H., Route 1, Box 76A, Prospect, Kentucky 1952
Sharp, Prof. A. J., Department of Botany, University of Tennessee, Knoxville 16, Tennessee 1940
Shaver, Dr. Jesse M., 1706 Linden Avenue, Nashville 12, Tennessee 1934
Sherman, Dr. Hope, Pleasant Valley, Connecticut 1951
*Shields, Mr. Edward M., 1249 South Basin Lane, Sarasota, Florida (winter) Twilight Park, Haines Falls, New York (summer) 1940

Short, Mrs. Donald H., 1801 San Antonio Avenue, Berkeley 5, California 1957
Shuck, Dr. Arthur L., Department of Biology, Southwestern State College, Weatherford, Oklahoma 1950
Sidney, Mr. Cedric, 111 Rosewood Drive, Hammond, Louisiana 1941
Simon, Mr. Andrew, Bluemont Nurseries, Box 219, Monkton, Maryland 1951
Simon, Mrs. Stanley D., 1030 Elm Park Drive, Cincinnati 16, Ohio 1951
Simpson, Mrs. Walter, 22 Prospect Street, New Hartford, Connecticut 1957
Singeltary, Miss Mary L., Kissimmee, Florida 1934
Skidmore, Mrs. Andrew T., Cedar Crest, Pleasant Valley, New York 1950
*Slater, Mr. William A., Hunt, Texas 1933
Smith, Dr. A. C., National Science Foundation, Washington 25, D. C. 1931
Smith, Dr. A. V., 5620 Colorado Avenue, N. W., Washington, D. C. 1939
Smith, Mrs. E. J., 3800 East 57th Street, Maywood, California 1957
Smith, Mrs. Eugene R., P. O. Box 131, Willits, California 1957
Smith, Mr. Ewart G., 147-151 High Street, Christchurch, C. 1, New Zealand 1955
Smith, Rev. Jesse F., 347 Main Street, Suffield, Connecticut 1950
Smith, Miss Marion L., 429 South Willard Street, Burlington, Vermont 1953
Smith, Miss Ora B., 821 Bergen Avenue, Jersey City 6, New Jersey 1939
Smith, Mrs. P. G., 542 Tioga Trail, Willoughby, Ohio 1956
Smith, Mrs. Paul M., 4315 West 174th Street, Torrance, California 1957
Snyder, Mr. Franklin D., 825 East Tugalo Street, Toccoa, Geqrgia 1953
Sobol, Miss Eva, 1080 Anderson Avenue, Bronx 52, New York, New York 1953
Solmitz, Mrs. Hertha, 2128 Veteran Avenue, Los Angeles 25, California 1957
Somerville, Mrs. Mary F., 978 Lincoln Way East, Chambersburg, Pennsylvania 1923
Soper, Prof. James H., Department of Botany, University of Toronto, Toronto 5, Canada 1952
Stanton, Mr. J. P., Fowler Chapter, Future Farmers of America, Fowler, California 1957
Starker, Mr. Carl, Jennings Lodge, Oregon 1951
Stauffer, Dr. R. Eliot, Kodak Park Works B59-2, Eastman Kodak Company, Rochester 4, New York 1952
Steere, Prof. William C., Department of Biology, Stanford University, Stanford, California 1935
*Steil, Dr. William N., 1926 North 53rd Street, Milwaukee, Wisconsin 1916
Stevens, Mrs. Leslie B., 95 Grove Street, Plantsville, Connecticut 1949
Steward, Mr. Orville M., P. O. Box 19, Fordham Road Station, New York 58, New York 1951
Steyermark, Dr. Julian A., Chicago Natural History Museum, Chicago 5, Illinois 1948
*Stockman, Charles C., II, 153 High Street, Newburyport, Massachusetts 1946
Stockwell, Miss Lillian N., 114 Bay Street, Alameda, California 1957
Stokes, Mrs. Francis J., The Mill, Darlington, Maryland 1940
Stokey, Prof. Alma G., Department of Plant Sciences, Mount Holyoke College, South Hadley, Massachusetts 1949
Stone, Miss Edna L., 3216 44th Street, Washington 16, D. C. 1928
Stone, Mr. Orra L., 22 Pearl Street, Clinton, Massachusetts 1951
Storer, Mr. Robert W., Museum of Zoology, University of Michigan, Ann Arbor, Michigan 1944
Storey, Mr. Oliver W., 2 Santa Cruz Boulevard, Santa Barbara, California 1934

Stoudt, Dr. Harry N., Department of Biology, Temple University, Philadelphia 22, Pennsylvania 1949
Stowell, Mrs. E. E., R. D. 1, Baileys Mill Road, Basking Ridge, New Jersey 1956
Suits, Mrs. Elihu E., 172 South Santa Cruz Street, Ventura, California 1957
Swan, Mrs. Joseph R., Farmington, Connecticut 1956
Swan, Mrs. William W., 3630 Coliseum Street, New Orleans 15, Louisiana 1957
Sweet, Mr. Merrill H., P. O. Box 44, East Canaan, Connecticut 1954
Swendsen, Mrs. Lucille Evans, 211 Illinois Street, Vallejo, California 1936
Swinscow, Dr. T. D. V., Everley, London Road, Knebworth, Hertfordshire, England 1957

Tanger, Mrs. Charles Y., 318 North President Avenue, Lancaster, Pennsylvania 1930
Tardieu-Blot, Mme., Museum National d'Histoire Naturelle, 57 Rue Cuvier, Paris V, France 1955
Taylor, Dr. Aravilla M., Andes, New York 1923
Taylor, Prof. T. M. C., University of British Columbia, Vancouver, Canada 1932
Teresita, Sister M., Holy Family Convent, R. F. D. 1, Manitowoc, Wisconsin 1944
Thacher, S. Charles, 2918 Brownsboro Road, Louisville 6, Kentucky 1953
Thomas, Mr. John U., 2130 Bowdoin Street, Palo Alto, California 1955
Thorne, Mr. Frederick, Pilot Knob, New York 1953
Thurston, Mr. Edward D., Jr., Sharon, Connecticut 1937
Tierney, Mrs. George, 593 Buchanan Street, Hillside 5, New Jersey 1953
Tilley, Mr. Trenor P., 1356 Northampton Street, Holyoke, Massachusetts 1921
Tillson, Mr. T. M., 3114 West 77th Street, Los Angeles 43, California 1957
Timpson, Miss Margaret, Longwood Crossing, Cedarhurst, Long Island, New York 1952
Tindale, Miss M., Botanic Gardens, Sydney, Australia 1951
Tooley, Mr. Marvin, 4830 Waltham Drive, Corpus Christi, Texas 1956
Traver, Mrs. Oliver, 3539 Muirfield Road, Los Angeles 16, California 1957
Tripp, Mr. Henry, 31 East Tenth Street, New York 3, New York 1954
Trudell, Mr. Harry W., 1309 Highland Avenue, Abington, Pennsylvania 1919
Truesdell, Mr. Horace, Bluemont, Virginia 1948
Truffin, Sr. Marcial, Villa Mercedes, Calle 72, No. 4503, Marianao, Cuba 1956
Tryon, Dr. Alice F., Department of Botany, University of California, Berkeley 4, California 1947
Tryon, Dr. Rolla M., Jr., Department of Botany, University of California, Berkeley 4, California 1932
Turner, Mrs. H. M., 88 Barnett Street, New Haven 15, Connecticut 1930

Valentine, Mrs. Elizabeth A., P. O. Box 186, Furlong, Bucks County, Pennsylvania 1946
Van de Water, Dr. C. M., 264 Hillside Avenue, Chatham, New Jersey 1947
Van de Water, Mrs. Elinore S., 264 Hillside Avenue, Chatham, New Jersey 1947
Verma, Mr. Satish Chander, University Botany Department, Khalsa College, Amritsar, Punjab, India 1955
Vernor, Mrs. W. Roy, 409 Leverin Avenue, Modesto, California 1957
Vincent, Mrs. Myron H., Chilmark, Massachusetts 1917

Vogler, Mr. Anton H., 145 South Courtland Street, East Stroudsburg, Pennsylvania 1952
*Voth, Dr. Paul D., Department of Botany, University of Chicago, Chicago 37, Illinois 1942

Wagner, Dr. Warren H., Jr., Department of Botany, University of Michigan, Ann Arbor, Michigan 1940
Walker, Mr. Albert N., 300 North Edgewater Road, North Sacramento 15, California 1954
Walker, Mr. Langley G., 65 Bellevue Avenue, Summit, New Jersey 1957
Walker, Miss Mary, 805 Pershing Square, Lynchburg, Virginia 1955
Wall, Mrs. Thomas, 1551 30th Avenue, West, Seattle 99, Washington 1957
Walters, Mrs. L. A., 9422 Broadway, Temple City, California 1955
Waltzer, Mrs. Ruth E., R. R. 2, Box 178-A, Sumter, South Carolina 1955
Watlington, Miss Tommie, 1409 Seminole Drive, Greensboro, North Carolina 1956
Watson, Mr. Reeve T., Route 1, Box 35, Gilroy, California 1957
Watts, Mr. Andrew J., 8836 S. E. Stark Street, Portland 16, Oregon 1958
Webb, Mrs. C. G., 20 West Avenue, Wellsboro, Pennsylvania 1956
Webber, Mr. C. L., 685 Candalaria Boulevard, Salem, Oregon 1957
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West, Mrs. A. J., 2833 Puesta Del Sol, Santa Barbara, California 1957
West, Dr. Erdman, Florida Agricultural Experiment Station, University of Florida, Gainesville, Florida 1942
West, Mr. George A., Chosen, Florida 1952
West, Mr. Nelson, East Jewett, New York 1955
Wheeler, Mr. Harry, 726 Valley View Avenue, Monrovia, California 1957
Wherry, Prof. Edgar T., Botanical Laboratories, University of Pennsylvania, Philadelphia 4, Pennsylvania 1918
Whitehead, Mr. Jack, 1841 West 67th Street, Los Angeles 47, California 1936
Whitehouse, Dr. Eula, Box 739, Southern Methodist University, Dallas 5, Texas 1950
*Whitney, Mrs. Elsie G., 104 Adams Place, Delmar, New York 1930
*Wiggins, Dr. Ira L., Dudley Herbarium, Stanford University, Stanford, California 1932
Wiley, Miss Farida A., American Museum of Natural History, New York 24, New York 1927
Wilkens, Mr. Hans, 424 South 15th Street, Reading, Pennsylvania 1927
Willi, Mr. Edward J., 125 East 91st Street, New York 28, New York 1955
Willier, Miss Lillian E., 320 Sheridan Street, N. W., Washington, D. C. 1953
Wilson, Mrs. Ora M., 4544 Kensington Drive, San Diego 16, California 1957
Winne, Dr. William T., 2517 Troy Road, Schenectady 9, New York 1950
Winsor, Miss Ellen, 658 Brooke Road, Wayne, Pennsylvania 1954
Witschen, Mrs. William J., 217 West Sixth Avenue, Roselle, New Jersey 1951
Woodson, Mr. Allen E., 191 Tivoli Way, Sacramento 19, California 1957
Wright, Mrs. C. H. C., 9 Lowell Street, Cambridge, Massachusetts 1935
Wright, Miss Mary F., 231 Winona Street, Philadelphia 44, Pennsylvania 1925

Yopp, Mr. John, 3443 Afton Avenue, Paducah, Kentucky 1957
Young, Mr. Charles H., Jr., 1136 New Hampshire Street, Lincoln, Nebraska 1958
Young, Mr. Stanford, 234 North Thomas Street, Apartment 4, Arlington, Virginia 1956

Zachau, Mrs. Marie, 603 East Kelso Street, Inglewood, California 1957
Zelley, Miss Grace S., 960 Columbus Road, Burlington, New Jersey 1942
Ziegler, Dr. A. W., Department of Botany, Florida State University, Tallahassee, Florida 1950

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